ELECTRICAL REVIEW

ILLUSTRATED.

A WEEKLY JOURNAL OF

Electric Light, Power, Telephone, Telegraph and Scientific Progress.

VOL. 15, No. 5. WEEKLY. | NEW YORK, SATURDAY, SEPTEMBER 28, 1889. | $3 per annum. Single Copies, 10 Cents.

Copyright, 1889, by ELECTRICAL REVIEW PUBLISHING COMPANY, 13 Park Row, New York.

Entered at Post Office, New York, as Mail Matter of the Second Class.

Electro-Magnetic Permutation Lock.

There is ever a strife between the burglar and the safe maker, which latter, of course, includes the locksmith. It is a sort of see-saw. The burglar blows open a safe or picks a lock—the safe man or the lockmaker sees the weak spot, and stops the leak. Then the burglar gets at it again and accomplishes his designs, and the maker again foils him. The see-saw has been going up and down, up and down, ever since the first strong box was made.

The electro-magnetic permutation lock, the invention of Mr. F. Sedgwick, of Chicago, calls to its service electricity and electro-magnetism. All who are familiar with permutation locks are aware that these are made up of a number of independent discs, each with a lug on the back and face, so arranged as that when the shaft is turned, one which is fastened rigidly on the shaft, having a projection upon its face will, when it has accomplished a complete revolution, engage with the lug upon the second disc, and so on until all the loose discs will revolve as the shaft is turned.

Fig. 1 shows a front elevation of the lock, removed from the safe or vault door, and with the face plate taken away, the bolt S being thrown, or locked. In this figure is shown also an electro-magnet with all the wire connections leading to the dial, Fig. 2, and the battery V. The dial is made up of 12 metallic blocks and an equal number of insulating spaces. The current as shown flows from A^1 to the shell of the lock, thence to one of the electro magnet coils, via wire B^2, plug contact, rotating contact arm Y, plate W, and to battery V.

It will be seen that contact through the other helix is broken at the plug switch or plate. No wire is in sight except at terminals.

Fig. 2 shows the various discs, only the face of one of which is shown in Fig. 1. In the periphery of each of these a notch is shown which, when the combination is properly manipulated, permits the lever, shown upon the top of the disc G, to drop down, and by moving with the wheel, pull back the bolt to unlock, or "shoot" the bolt to lock the safe.

The method of operating the combination, as in ordinary permutation locks, consists in first setting up the discs. Over the face of the dial plate shown, an ordinary safe dial is placed containing either letters or figures, which is revolved by means of a knob carrying with it the contact hand Y.

Now it is evident from what has been said, and by reference to Fig. 2 where the lugs or projections are shown in each disc, that a rotary movement of the knob spoken of would carry the contact arm Y alternately over the metallic plates and the intervening insulations, breaking and closing the circuit 12 times for each complete revolution of the knob.

At each closing the armature shown in Fig. 1, between the pole pieces, would be drawn to the left, and at each break it would be restored to its position as shown. The mechanism is simple by which this action is converted into a rotary movement of the first wheel.

This motion continued, picks up one after another of the discs, until all move together on the main shaft. Now the operator changes the plug so as to send current through the opposite helix, and by revolving the knob in the opposite direction, a given number of turns, and stopping at a figure specified in the combination, the notch in the periphery of the first disc is brought directly beneath the lever which must drop before the bolt can be withdrawn. Again the operator changes the switch plug and reverses the motion, so as to revolve the second disc, stopping at the proper point to bring the notch in line with that of disc number one. Then he reverses again, and so on, until the lever, which has now no disc to rest upon, drops down into the slot, and the last reversal withdraws the bolt.

Thus, suppose the lock is a three disc combination, turn four complete revolutions to the right and stop on 30. Then backward three revolutions and stop on 20. Twice to the right to 45, then back, and the bolt would be withdrawn. This is the simplest and most easily understood of the several forms of Sedgwick's locks, one of which has a time arrangement, somewhat similar to the ordinary time vault lock.

A more efficient and complete lock than that described does away with the reversing switch altogether. In this form there are four binding posts surrounding the knob, each connecting to a separate electro-magnet coil within the lock. As the knob is turned, the current is sent through these electro-magnets successively, by means of a contact plate having several divisions, so that one complete revolution of the knob sends the current several times through the series of magnetic coils. Revolving within influence of the magnetism so developed, an armature, with a rapid step-by-step movement, carries gear wheels to actuate the slotted discs, backward or forward as the knob is rotated.

Having locked the safe, the proprietor or professor of the combination, desiring to prevent the possibility of some one getting into the box or tampering with it, lifts the knob and its attached contacts out of the face of the safe and carries it away, if he chooses. He may even carry it to a distant city, if he chooses, and operate the lock by attaching it to a borrowed telegraph line from his room in a hotel.

Fig. 1

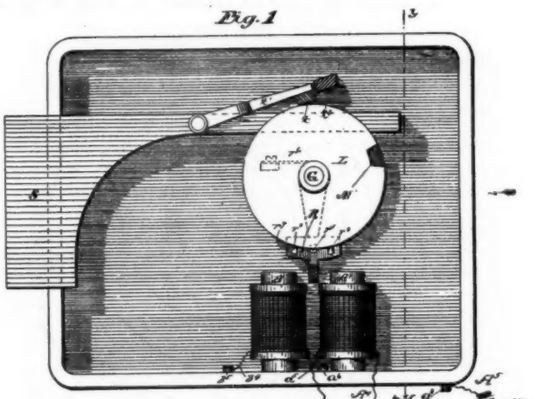
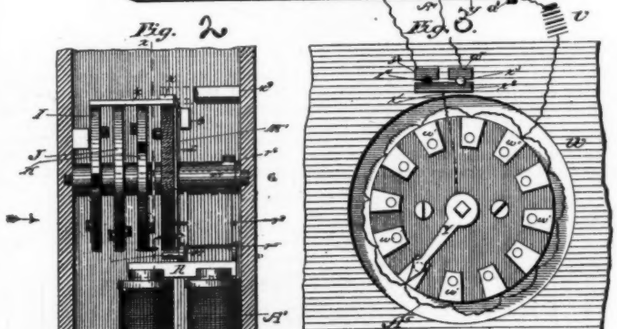


Fig. 2



SEDGWICK'S ELECTRO-MAGNETIC LOCK.

Influence of Electric Light on Plants.

In the course of a recent lecture before the Royal Society, England, Dr. Siemens placed a pot of budding tulips in the full brightness of the electric light in the meeting room, and in about 40 minutes the buds had expanded into full bloom. Dr. Siemens' experiments have been made with quick growing seeds and plants like mustard, carrots, swedes, beans, cucumbers and melons. The pots, the lecturer stated, were divided into four groups, one of which was kept entirely in the dark, one was exposed to the influence of the electric light only, one to the influence of daylight only, and one to daylight and electric light in succession. The electric light was applied for six hours each evening —from 5 to 11—and the plants were then left in darkness during the remainder of the night. The general result was that the plants kept entirely dark soon died; those exposed to the electric light only or to daylight only throve about equally, and those exposed to both day and electric light throve far better than either.

American Institute of Electrical Engineers.

The thirty-seventh meeting of the Institute was held at the house of the American Society of Civil Engineers, 127 East Twenty-third street, New York, on Tuesday, September 10th, 1889. The meeting was called to order at 8 P. M. by Vice-President Martin, who said:

Gentlemen, this evening we have our thirty-seventh meeting, and the first of the present season. The paper which we shall have read to us is by Lieutenant F. Jarvis Patten, on "Alternating Motors—The Evolution of a New Type." Judging from the full attendance on so stormy an evening, the subject is one of great interest to us all, and I therefore have much pleasure in calling on the Lieutenant to read his paper.

"ALTERNATING CURRENT MOTORS—THE EVOLUTION OF A NEW TYPE," BY LIEUT. F. JARVIS PATTEN.

On giving our secretary the title of this paper, it was my purpose to treat the subject in a broader light, and to show the progressive steps in a series of experiments which led eventually to the type of machine that I shall bring to your notice this evening. The recent and urgent claims of other work have rendered such a treatment impossible at the present, and I shall limit the paper to a description of a new alternating current motor, one form of which is shown in the accompanying drawing.

The place that the alternating current electric motor is destined to fill in the industrial arts is familiar to you all, and the various ways known to the scientific world by which such machines may be rendered operative, have been ably considered and elaborately discussed in the Institute papers of the past two years by Professor Thomson, Dr. Duncan and Mr. Tesla. We are thus all more or less acquainted with the prominent difficulties of the problem.

My experience in common with that of my predecessors teaches that the alternating current motor has a strong and persistent disposition to stand still, and when persuaded to motion it is apt to be a sort of "go-as-you-please" machine, and asserts its inherent right to turn in either direction indifferently; direction of rotation in some cases being purely a matter of chance. I shall not have much to say about efficiency, as my experiments with large machines are not sufficiently advanced to furnish any reliable data; but I will endeavor to give a general solution of the problem designed to meet the following conditions of practice:

1st. A machine that will start itself independently of the speed of the generator or number of alternations of current per unit of time.

2d. A machine that has but one direction of rotation and cannot reverse under any conditions of current alternation.

3d. A machine that is not necessarily synchronous with the generator, revolution for revolution.

4th. A machine in which reversals of current direction do not produce corresponding reversals of magnetism in any iron part when the machine is in motion at its normal speed and maximum efficiency.

5th. A machine of simple form, having an ordinary continuous wound armature revolving in a single or two-pole field.

Referring now to the figures, which are simply diagrams of the circuits and operative parts, we have in Fig. 1 an ordinary closed circuit armature shown as a Gramme ring merely for convenience of illustration, the points of the winding intermediate between the eight coils being connected in the usual way to the eight segments or bars of an ordinary Gramme collector, and it may be well in passing to note here the functions of this collector. It is not a commutator in the strict sense of that term, as it does not

rectify or re-direct reverse or opposed currents. If the brushes b^1 and b^2 were held upon the outside wire of the ring, the same results would follow, and the Gramme collector, properly so called, simply transfers the brush contact from point to point of the continuous ring winding. If a source of direct current be interposed between the terminals A^1 and A^2, current will flow continuously from brush b^1 to b^2 downward through the right and left hand halves of the ring in the direction of the arrows k^1 and k^2, making, say a south pole in the ring at the upper point S, and a north pole at the lower point n. With a continuous current these poles would be continuously maintained, and placed in the magnetic field indicated by N and S the armature would continuously revolve in the direction indicated by the arrows $K K$. If now a source of alternating current be inserted between the terminals A^1 and A^2, the polarities of the ring would be reversed at each successive alternation of current, and if a direct impulse, indicated by the single arrows, in the external circuit produced the poles n and s in the ring, the reverse impulse, indicated by the double arrows, would produce the opposite polarities n^1 and s^1 at the same points, and the tendency to motion would be reversed if the fields remained the same, but, it will be noted, the motion would be in the same direction still if the fields were also reversed by the same reversal of current. If, however, the fields were maintained constant, as indicated by the large letters N and S, and some device could be contrived by which at each reversal of the alternating current the brushes b^1 and b^2 could be made to change position, either mechanically or otherwise, then with an alternating current a constant polarity, s and n, would be maintained at the upper and lower points of the ring—for then a direct impulse, starting from A^2 to the right, would enter the ring through the brush b^1, flowing down both sides in the direction of the arrows k^1 k^2, out through brush b^2, and back to the source at A^1. The reverse impulse, indicated by the double arrows, would start from A^1 to the left, going to brush b^2, and, if we now suppose this to have changed places with the brush b^1, the reverse current would then enter the ring at s, and, flowing down both sides in the direction of the arrows k^1 and k^2, would leave through n and the brush b^1, and so back to the source a^2, maintaining the polarity of the ring the same as before. If the brushes could be thus changed at each alternation, the polarity of the ring would be maintained constant with an alternating current. While, however, it is quite impracticable to thus cause the brushes to change position mechanically at each reversal of the current, it is perfectly feasible to produce the same effect without the mechanical change. The means of accomplishing this result are indicated in Fig. 2, which is identical with Fig. 1 with a single exception. There are eight coils, as before, and eight bars in the collector; the odd numbered bars, 1, 3, 5 and 7, are connected to the same points of the ring as before, c, f, h and j, but the even numbered bars, 2, 4, 6, 8, are connected respectively to points of the ring diametrically opposite them, bar 2 to the point d, bar 4 to the point g, and so on each even numbered bar to a correspondingly opposite point of the winding. If now a source of alternating current be interposed between the terminals A^1 and A^2, and we make the single supposition that the ring shall turn through an arc of the circumference equal to that covered by one bar of the collector during each alternation of current, we shall still maintain a constant polarity at the upper and lower points of the ring without causing the brushes to change position mechanically.

Thus a positive impulse starting from A^1 to the left and indicated by single arrows enters the ring at b^1, flows down both sides to n, producing the ring polarities s and n out brush b^2 and back to source at A^2. The reverse impulse being in the opposite direction will start from A^2 to the right, go to brush b^2 which we will now suppose bearing on segment 4 of the collector, whence it will go by the inverse connection to the opposite point S^1 of the ring, then down both sides in the same direction as before to the point n^1, thence back to the opposite segment 8 out, brush b^1 now bearing on this segment and back to source at A^1.

The reverse currents therefore, under the assumed conditions, are caused to maintain a constant polarity in the ring, so that in a constant field its tendency to motion would always be in the same direction with an alternating current in the armature. It will be further noted that the alternating current is not re-directed or commuted in the strict sense of the word, and we may enunciate the fundamental principle which underlies the construction of this type of machine as follows:

"The poles of any closed circuit may be maintained constant with an alternating current by causing opposite impulses to traverse the circuit in opposite directions." The direct and inverse connections, shown in Fig. 2, have precisely this effect, when, as supposed, a single bar of the collector passes under the brushes at each reversal of current. The connections, c c, d d, f f, etc., in Fig. 2 may have any form, and other bars may be interposed between their extremities without affecting in any way their functions as connectors. This step is shown in Fig. 3, where another collector bar 1c, 2d, 3f, etc., is inserted in each of the connections c c, d d, etc., of Fig. 3, thus making another collector shown outside the first to avoid confusion of the drawing, while for the same reason the source of alternating current A^1 A^2 is placed inside the inner ring. As the polarities s and n of the ring are maintained constant, as

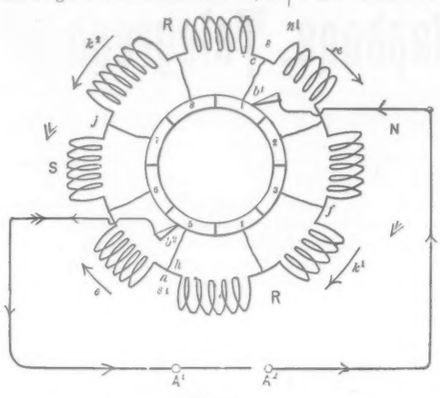


FIG. 1.

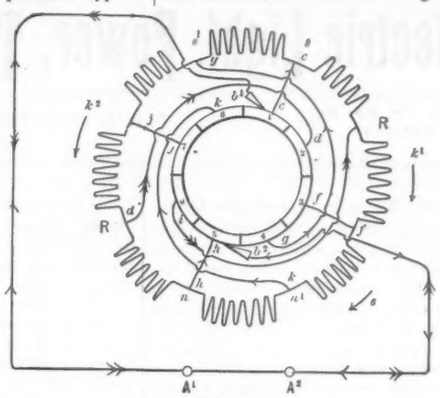


FIG. 2.

previously described, with an alternating current, and current is constant in direction from s downward through the right and left halves of the ring to n, so must necessarily any current be constant in direction which is lead from brushes through any shunt circuit connected to the segments 1c and n of the outer collector; a field circuit of constant direction may therefore be shunted from this outside collector. This is shown in Fig. 4, in which 12 coils are shown in the ring and 12 bars in each collector connected alternately direct and inverse as before. Tracing now two opposite impulses of current, we have the first indicated by the single arrows from source A^1 to segment 1 of the inner collector, thence to segment 1 of the outer collector, where the current divides, part going down the right and left hand halves of the ring to n and part out brush b^2 through the field circuit making the poles N and S, back to brush b^4 segment 7 of outer and segment 7 of inner collector to the terminal A^2 of source. If the armature be supposed now to turn through the space covered by one collector bar, the reverse impulse can be traced as follows: Starting at A^2 in the opposite direction to brush b^2 now bearing on segment 8 of the inner collector thence through the reverse connection to segment 2 of the outer collector, now under brush b^2 where the current divides going part as before down the right and left halves of the ring making a south pole at s^1 and a north pole at n^1 as before, and the other part out of brush b^2 through the field circuit in the same direction as before back to brush b^4 now on segment 8 of the outer ring thence to the reverse connection back to segment 2 of the inner ring, now in bearing with brush b^1 and so returning to the source at A^1. Thus the two impulses of opposite direction have been made to traverse both armature and field circuits in the same direction, we have, therefore, with an alternating current constant armature polarity and constant field polarity, and therefore a constant tendency to motion in the same direction.

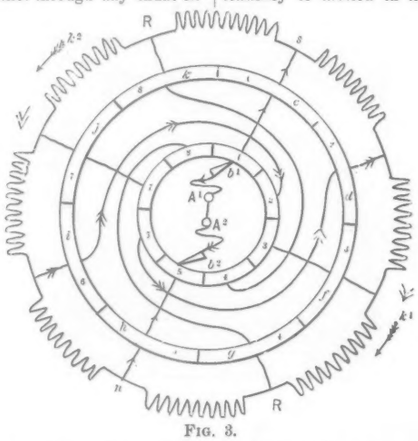


FIG. 3.

Not only this but the further condition is fulfilled that there are no reversals of magnetism in any iron part so long as one bar in the machine, as shown in Fig. 4, passes under the brushes at each alternation of current. It remains to show how this is brought about. Referring again to Fig. 4, let it be supposed that the first impulse of current did not cause the armature to turn through the arc of the circumference subtended by one segment, but all the brushes still bore on the same segments, as shown in the figure, and the reversals of current continued. By tracing the circuits it will be seen that each reversal of current reverses the polarity of both field and armature, and with either direction of current or rapid reversals there will be a constant tendency to motion always exerted in the same direction.

The machine under these conditions becomes therefore simply a direct current machine on an alternating current circuit with a constant tendency to start in one direction. Assuming the machine, therefore, self-starting, it will continually gain in speed until the condition is fulfilled of one segment passing the brushes at each alternation, for it then becomes in the broad sense a synchronous alternating motor. The current then produces no reversals of magnetism and there is a true alternating current in the armature circuit, producing however no reversal of armature polarity; and a current of constant direction in the field. Under these conditions the motor is self-regulating,

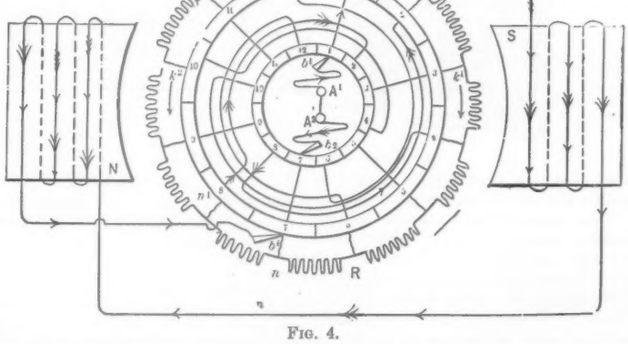


FIG. 4.

moving at a constant speed and with a maximum rotary effort.

It is not however essential that one bar should pass the brush at each alternation, as any number may be caused to do this depending upon the speed required and the number of coils upon the armature. This is illustrated in Fig. 5, where the complete machine is shown. There are 24 coils in the armature, 24 bars in the outside collector and 32 bars in the inside one, this latter being composed of 24 connecting and eight insulating bars. The connecting bars of the inner ring are numbered to correspond with those of the outer ring around to the right from one to 24; the insulating bars, drawn shaded, separate the others into groups of three. In this machine three segments, 1, 2, 3, in the outer ring are connected direct to the corresponding segments 1, 2, 3 of the inner ring, likewise the opposite three 13, 14, 15 of one ring are connected direct to 13, 14, 15 of the other. The next group of three is connected inversely 4, 5, 6 of the outer ring to the diametrically opposite bars 16, 17 and 18 of the inner, and the corresponding opposite group 16, 17, 18 of the outer ring are likewise connected inversely to the diametrically opposite group 4, 5 and 6 of the inner ring. The remaining segments are connected in the same manner, but the connections are omitted to avoid confusion of the drawing. The operation of the machine is evidently the same as that shown in Fig. 4, except that the required conditions are fulfilled in this instance when three bars of the collector pass under the ring at each alternation of current, and as there are 24 segments arranged in groups of three, the machine, at its normal speed, would make one revolution for every eight alternations of current, and connected in a circuit supplied with 16,000 reversals per minute its nominal speed would be $\frac{16000}{8}$ =2,000 per minute, and with 48 segments arranged in groups of three, its speed would be 1,000 per minute. The blank segments insulating the groups of the inner ring are connected to the extremities of a rheostat Rh. Rh., which is enclosed inside the commutator and is designed to offer a path for the alternating current such as there may be, and prevent its absolute rupture at a period of change from one group of segments to the next; they also serve an important purpose in preventing a dangerous short circuit which would be occasioned by the inner brush bridging two groups of segments oppositely connected.

It follows, as a matter of course, as the machine starts as a direct current motor connected in an alternating circuit, rapid reversals of magnetism will at first be produced in all the iron cores, and these should be made of laminated iron to prevent undue loss by heating at the period of starting. The machine, in fact, starts as a direct current motor, and automatically changes to a sort of synchronously alternating motor. When it gains its normal speed at this point it is self regulating, and its capacity of doing work is a maximum.

Fig. 6 shows a plan of the machine as constructed. It consists simply of an ordinary closed circuit armature in a single field; e e is the ordinary collector, really a part of the armature circuit, from which the brushes b^3 b^4 take a current of constant direction to the field shunt; a e is the reversely connected commutator, and the brushes b^1 b^2 bearing upon this commutator are connected to the terminals of the alternating current circuit.

I might add to the paper the fact that the inner commutator, the one which is the ordinary commutator of the Gramme ring winding, does not perform the ordinary functions, as the brushes bearing on this collector require no adjustment, it being merely a rubbing contact from which the shunt field circuit is taken as a derivation to the main circuit of the machine. With that exception, I think the machine is fully explained in the paper.

Mr. C. O. Mailloux: I would like to ask Lieutenant Patten in regard to the possible presence of sparking—whether it occurs to an injurious extent or not?

Lieut. Patten: The sparking being due to the electro-motive force at the point of breaking, it will necessarily occur during the starting of such a machine, and more than ordinarily when it is out of synchronism with the alternating current. At the outset it can be easily seen that the alternating current is liable to be broken at a point where this electro-motive force is high, and therefore the sparking would be very violent. I have endeavored to obviate the trouble due to that cause in the machine—the device is shown in Fig. 5. If you will notice the circuits carefully, it will be seen that the circuit of the alternating current is never broken. If the brush comes on to one of the dead segments or shaded segments connected with the rheostat before the alternating wave has come to zero, it finds a path which is at first in parallel with the machine circuits, and then becomes a separate path for the alternating current during its change, whether this change begins at a high or low low electro-motive force. Of course, as the machine starts, this may happen at any period of the wave, and the brushes passing over these segments connect with the resistance at the end of the group, and before it has left the group the current is already short-circuited through this rheostat. So that the alternating current always has a path and the sparking will not be excessive, judging from what little experience I have had.

Mr. R. S. Dobbie: I would like to inquire whether the field magnets are laminated, and whether the lamination would be necessary only while the machine was starting up as an alternating current motor or before the synchronism is attained. Another question I would like to ask would be if the maximum torque of a machine is at one-third speed, what comparison is that to the torque of the same machine at full speed when the synchronism is attained?

Lieut. Patten: In answering to the first point, I would say, that there is no essential reason for laminating the field magnets for any other purpose, but it has been shown by quite conclusive experiments that a laminated machine has a very definite neutral line of field, which makes it simpler and better for taking the direct current shunt for the field from that point without having to arrange to make two sets of brushes movable instead of one set. With respect to the other point, the torque of such a machine depends, of course, entirely on its keeping in synchronism, and the result of the departure from that point is well known to all. That is the limit of the strain that can be exerted. When that is exerted the machine will stop; it will not then continue as a direct current machine.

Mr. Dobbie: My reason for asking that question was to find out if the motor will start on a full load.

Lieut. Patten: No; it will not.

Mr. Lemuel Wm. Serrell: I would like to ask how the currents are short-circuited through the rheostat when the ends of the rheostat are connected to the insulator blocks in the commutator?

Lieut. Patten: The question is a pertinent one, inasmuch as the term "insulated" was used in the paper. They are not insulated segments in the true sense of the word. They are all connected with each other, and are of conducting material. The mistake is my own entirely in using the word "insulated" in any sense. The insulating segments referred to are the same kind of segments as the others. They are simply other segments not connected to the machine circuits a little narrower than the others.

Mr. Serrell: The shaded portions, as I understood, are insulated blocks, but, as is now explained, the shaded portion indicates a metallic connection separated from the rest of the commutator.

Lieut. Patten: No; they are simply segments the same as the others, but are connected to an interior rheostat which is not in the circuit of the machine. I think, as has just been suggested to me, that they should be called "isolating" segments instead of insulating segments. They are segments not connected with the circuit of the machine, but simply to the rheostat, which is shown in the drawing, and this rheostat is intended to take the current at the time the brush leaves the group which is connected with the machine circuits and so prevents sparking.

Dr. Allan V. Garratt: Another question in regard to the rheostat: Is the resistance of those coils gotten at by experiment, and if so what relation do they bear to the resistance of the machine itself?

Lieut. Patten: So far I have attempted to make the rheostat simply equal to the resistance of the machine, so that there would be as little change in the strength of the current as possible.

Mr. Mailloux: Is the resistance reactionary or simply dead?

Lieut. Patten: So far the resistance in the commutator is a dead resistance simply. It might theoretically be made to advantage of the reactive kind.

Mr. Mailloux: I should think that a machine of this kind, although it is of great theoretical interest and is an evidence of striking ingenuity, would be open to a defect arising from the fact that the current is a wavy one, no matter how rapid the periodicity is. There is always a very short time when there is no current. We may consider that the magnetizing current through the shunt is a succession of waves. Consequently there would be an oscillatory tendency in the magnetism, a tendency to rise and fall with it. If the magnetic core is laminated and of soft iron, I think that it will be able to rise and fall quite readily; in other words, quite rapidly enough to follow the fluctuations of the current. We know that it does so in transformers. Of course, there is a slight reaction in the substance of the iron itself—its "viscosity," due to hysteresis; at the same time it is not sufficiently great to interfere with the rise and fall of the magnetism, and the more perfectly the core is laminated the more rapidly the rise and fall would take place. Also the thinner the lamina; so that if the magnetic field is made of a very finely divided magnetic medium, and if the rise and fall can take place readily enough, it seems to me that there would be a certain amount of loss in consequence, which would be quite material under certain conditions and also a certain amount of loss due to the reactions following from mutual induction in the armature itself, because we can see that even when running at synchronism the current in the armature would be a succession of rises and falls, and although the magnetism of the armature is not reversed, yet the current is reversed through the coils, and that is not, perhaps, so disadvantageous as the fact that it is constantly rising and falling at a very rapid rate. I should think that the loss due to mutual induction, particularly in the presence of a magnetic body of permeability and susceptibility, such as the armature core has, would lead to a very important source of loss, and I should not expect that a motor built on that principle would show the efficiency which we might expect from other forms, for instance, as those forms suggested by Leblanc in France, and by Mr. Mordey in England.

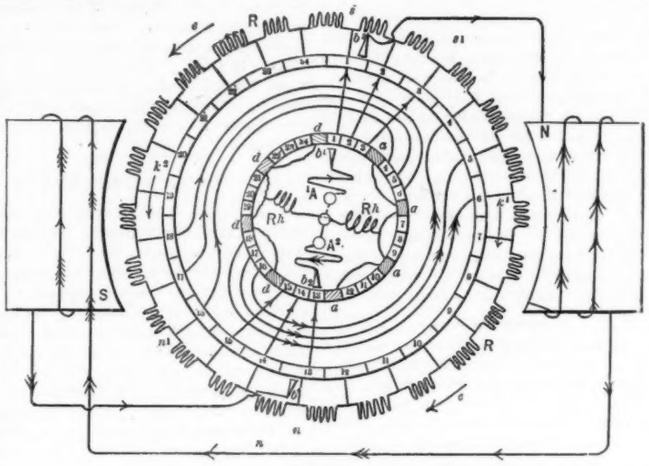


FIG. 5.

Mr. H. Ward Leonard: I would like to inquire whether the interruption of the current in the field is going to occasion any loss of energy, or heating of the field, or lack of efficiency?

Lieut. Patten: I might say in reply to that and answer at the same time a good many questions that might be advanced of a kindred nature, that my experiments have been very limited, and that it would require considerable investigation to determine that point definitely. I have no doubt that it does limit the action of the field, but to what degree, I do not know. But the current is broken when the machine is in synchronism at a point near its zero value. Of course, at 16,000 alterations per minute, the interruptions are so short that the field could not readily lose its magnetism, but whenever there is a break in the current, there must be some slight loss due to that.

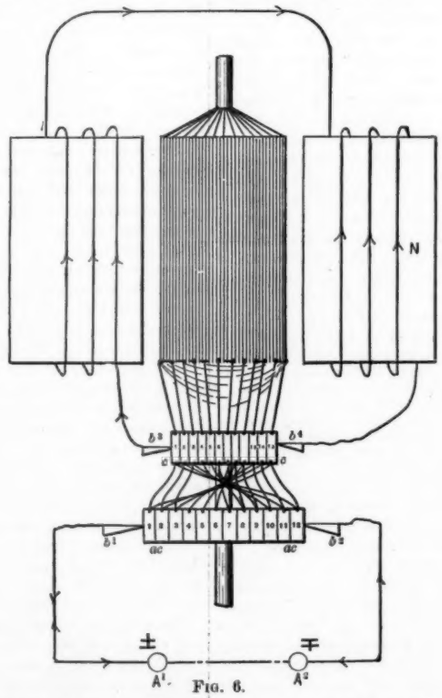


FIG. 6.

Lieut. Patten: I think not. The tendency of course is if it races to go to the double

(Continued on page 8.)

ELECTRICAL REVIEW

Published at 13 Park Row

P. O. BOX 3329.

GEO. WORTHINGTON, - Editor.
CHARLES W. PRICE, - Associate Editor.
T. J. McTIGHE, Electrician and Manager Patent Bureau.

REGISTERED CABLE ADDRESS:
"ELECTVIEW," NEW YORK.
TELEPHONE CALL, 546 JOHN.

Timothy W. Sprague, 196 Summer Street, is our representative at Boston, Mass.
Mr. C. C. Haskins, City Hall, Chicago, Ill., represents the REVIEW in the West.
George C. Maynard, 1419 New York Ave., Washington, D. C.
Charles Ffrench, European representative, 5 Park Place, St. James street, London, S. W.

SUBSCRIPTION.

United States and Canada, $3.00 per annum, in advance. Postage paid by publisher.
Great Britain and other foreign countries $5.00, in advance. Postage paid by publisher.

ADVERTISING.

Transient, 25 cents per line, nonpareil.

EDITORIAL ANNOUNCEMENT

Address all communications and make all Express Money orders, P. O. orders and checks payable to order of ELECTRICAL REVIEW, P. O. Box 3329, New York.

☞ No attention will be paid to communications without the *name and address of the writer.*

We invite correspondence from Electricians, Inventors, and the Telegragh and Telephone fraternity and those engaged in Electric Lighting, on matters pertaining to electrical and scientific subjects, and all facts of special interest in connection therewith.

We extend to manufacturers of electrical apparatus an invitation to send to this office any and all facts concerning their business which will be of interest to the public. We make no charge for publishing news.

Subscribers can at any time have the mailing address of their paper changed by sending both old and new address.

NEW YORK, SEPT. 28, 1889.

CONTENTS.

	PAGE.
Electro-Magnetic Permutation Lock	1
Influence of Electric Light on Plants	1
American Insitute of Electrical Engineers	1
Electrical Rapid Transit	4
Gamblers and Electricity	4
Electricity for Warfare	4
Electrical News:	
Our Chicago Letter	5
Our Boston Letter	5
Our Washington Letter	5
The Government to Possession of the Entire Telephone System in France	5
Electric Welding Profitable	5
Telephonic News	6
Extension of the American Electrical Works—A New Factory in Montreal	6
The Telegraphophone	6
The St. Louis Exposition	6
The Electric City	6
A New Company in Detroit	6
Electric Power in the South	6
Electro-Magnetic Separation of Gold	7
Telegraphic	7
Annual Meeting of the Street Railway Association	9
"Magnetic Vane" Ammeters and Voltmeters	9
Electricity and Powder	9
Electric Power	10
The New Baxter Motor	10
Quick Work at an Electric Light Station	11
Electric Light News	11
Kindred Interests	12
Cincinnati Electric Railway	12
The Entire Globe to be Lighted	12
Test of an Automatic System	12
Electrical Patents	12

It is worthy of note that no less an authority than Mr. Preece is reported to have recently said before the British Association that it is impossible to kill a criminal with any certainty by electricity.

The British government has the right of the use of the Delaney system of duplex telegraphy, and uses the system in its postal telegraph service. The royalties from this are all deposited with Baring Bros. & Co. The firm of Jones & Goodwin were interested in keeping the patent alive. The royalties are deposited in keeping to the joint account of the Standard Electric Manufacturing Company and Wendell Goodwin and Frank T. Jones. Justice Van Brunt, of New York, has given judgment for $23,347 in favor of Jones and Goodwin, and directing that Baring Bros. & Co. pay them that amount before paying any other royalties.

They are experimenting with electricity as the source of energy for propelling cabs in London, but we fancy it will be some time before a storage battery will be found to withstand the terrible jolting caused by the pavements of New York streets.

The largest lighthouse in the world has recently been erected at Hantsholm, on the coast of Jutland. The tower contains two steam engines, each of 35 h. p., for driving the two Meritens dynamos that supply the electric current for the gigantic lamp at the summit of the lighthouse. The lamp, which is constructed on Le Baron's principle, shows a constant light of 2,000,000 candle-power.

That electrical engineering has taken a foremost place among the manufacturing industries of the world, is exemplified in a striking way by the fact that a few days ago, at Glasgow, a casting of Siemens' steel was successfully run containing no less than 70 *tons of metal,* for the shaft of the monster Ferranti dynamo now under construction for the London Electric Supply Corporation. When turned, bored and finished, the shaft will weigh about 32 tons. It is seldom a steel casting of such magnitude has been made for any purpose; and when we reflect that this is for a dynamo, we begin to realize that electric lighting has a pretty firm footing.

Americans should be proud that one who is so prominently connected with electrical educational matters as Prof. Rowland, of Johns Hopkins University, should have received so marked a tribute in another branch of physics. Prof. Rowland has received a grand prize and a gold medal at the Paris Exposition for his photographic map of the solar spectrum and his concave gratings, which have been already described in the ELECTRICAL REVIEW. The grand prize and gold medal, which have also been conferred upon Johns Hopkins University for its publications, is no less a compliment to this thoroughly American Institution.

The disastrous fire which has recently destroyed the St. Joseph Exposition should suggest to the projectors of the International Exposition of 1892, in New York, that although there is small probability of the buildings being so constructed as to permit of their being destroyed by fire, yet much of their contents will be of a highly inflammable nature, and it will be the part of wisdom not only to prevent fire, but to provide the most effective means of putting it out. Never before will such a wealth of art treasure and costly wares have been gathered in one set of buildings. Never before will such an opportunity have been given to demonstrate the many uses of electricity. Conspicuous among these should be a complete system of perfect devices for the detection, location and extinction of fire. The electro-thermostat—or as it should be called—the electro-thermo-indicator, and the electrically actuated fire pump, could and should be made to offer practically perfect protection from serious fire.

The satisfaction given by the electrical method of purifying sewage in England is apparently all that could be desired. The time may not yet be ripe for such ideas in this country in the light of a refinement of municipal economy: but the time is at hand, in many locations, where the subject needs consideration as a greatly needed sanitary measure. Towns and communities are thickening along our streams, and the fashion is for each to take its water supply from a point up-stream and discharge its sewage at a point down stream. The consequence is one town on the stream may get pure water, and all the rest get—well, a little of everything. Filtration may and does effect some good, but not enough; it has no effect upon the matters which have entered into solution in the water. The electric treatment, however, it is claimed, purifies the sewage completely, leaving only water, and, if such be the fact, the sanitary difficulties are easily remedied by the erection of a suitable plant located to receive all the sewage, and discharge only clean water into the stream.

The proceedings of the Society of Arts, Massachusetts Institute of Technology for the twenty-seventh year, 1888-1889, has just been received. It contains abstracts of the 17 papers read before its members at its several sessions, and a glance at the titles of the papers and their authors, shows their value and the high standing of those who have appeared before the society. Among the papers, having an electrical interest, are the following: "The Eco Magneto Watchman's Clock," by C. A. White; "Transmitting Handwriting by Electricity," by W. E. Gump; "The Phonograph and Phonograph-Graphophone," by Prof. H. W. Vaughan; "Peculiar Rotary Motion Found in Lighting and other Electrical Currents," by Moses Greeley Parker, M.D.; "Recent Studies of Telephony Prosecuted in the Rogers Laboratory of Physics," by Prof. Charles R. Cross; "Electric Railways," by Capt. Eugene Griffin. Altogether the volume forms a most valuable and interesting contribution to contemporaneous electrical literature.

ELECTRICAL RAPID TRANSIT.

Several plans have recently been made public in this country looking towards the ultimate construction of one or more trunk lines of considerable length on which express and passenger business are proposed to be carried at a rate of not less than 200 miles per hour. One designer proposes a low, light car with an electric motor driving it, a development of the present system of electric street car propulsion; another proposes a series of successively energized stationary electro-magnets attracting the car or a body of iron attached to it; and other plans have been proposed, not necessary to detail here.

That a practical system capable of safe traffic at such a speed is a desirable consummation will not be denied by any one, but is it practicable?

Considering the speed first, there is really nothing to prevent it. The wheels of the average passenger coach are, in this country, 33 inches in diameter. At 60 miles per hour they make about 625 revolutions per minute, but frequently short runs of 70-mile rate are made, raising the speed to 725, which is considered far within the limits of safety. With wheels five feet in diameter the desired speed of travel would require but little over 1,000 turns per minute, which would be safe, considering the fact that the cars would be greatly smaller and lighter. The motive power would prove no difficulty. The problems which beset the designer of motors and other devices for street cars would not be any more difficult, and would be lightened by the facility with which insulation could be guaranteed, and the circuit divided into separate sections. Power required would be less by reason of the great reduction in weight of rolling stock and ability to use highly efficient stationary engines instead of present locomotives; indeed we think the fuel consumption per car mile would be far less than at present.

The permanent way in some respects might be more costly than the usual construction, but in others would be less. Cuts would not be so deep nor fills so high, because the system would be more or less independent of grade, and for that very reason the route could be made reasonably straight and curves of great radius only adopted.

These are only a few reflections on leading points, but the more one studies the matter the more possible it seems. Not a single engineering difficulty seems to stand in the way. Mechanical and constructive features of rolling stock are much simplified in comparison with steam operated roads, and the electrical questions involved seem quite capable of solution. All that is lacking is capital and backbone to make extreme rapid transit an accomplished fact. Already something is doing in this direction, and we hope ere long to give practical details to our readers.

We venture the prediction now that within five years there will be more than one trunk line in operation in this country carrying through passengers regularly at an average speed of nearly 200 miles per hour.

GAMBLERS AND ELECTRICITY.

It has recently been suggested that instead of using the rack, so well known to transatlantic travellers, that the dishes might be held on the table during rough weather by means of electricity. This would be accomplished by the use of a number of electro-magnets placed immediately below the table cover, which could be made by closing an electric circuit, to powerfully attract the various dishes, they having been provided with iron bottoms.

A similar device has been designed by certain gamblers who, like the rest of the world, are quick to avail themselves of electrical aids. The loaded dice of to-day have the same specific gravity, but have a piece of iron inserted opposite the side which is wanted to turn up throughout, so that when thrown on an ordinary table they are governed only by the law of chance, but when cast on the magnetic table at the gambling den can be made to turn up "three sixes" or not at the will of the person controlling the secret button connecting the battery with the electro-magnets.

ELECTRICITY FOR WARFARE.

Remarkable progress has recently been made in this country in the application of electricity to purposes of warfare, and work of a very high order has been done at the government torpedo station, where a long and elaborate experimental course has been carried out. The electric light, especially, is coming to play a most important part in modern warfare, and American investigators in this field, many of whom have contributed so materially to its present state of development, will be interested in the report of some experiments which took place in the Solent, England, last week. As a better means of defending the roadstead an electric search light has recently been erected on the Spit, near Hurst castle, opposite the Needle's passage, and six gunboats, with several torpedo craft, tried, under cover of night to effect an entrance from the westward without being perceived. The attempt was a failure, as each vessel was spotted by the powerful light when miles off, and the guns were all ready when they came within range. To make matters worse for the attacking flotilla, the smoke which they created in profusion, so as to prevent the ships from being seen, was blown astern by the wind, and the result was a complete victory for the electric light.

The mining district of Northern Michigan, as well as that of the opposite shore of the Lake, will soon be lighted extensively by electricity. In some of the leading mines near Ironwood, Mich., notably the Norrie, Pabst and others, the decision to light with electricity is being watched with deep interest by owners and miners. The surface workings on the Marquette and Menominee ranges are being illuminated by electricity, but the caverns and underground galleries are still smoked by the dirty kerosene lamps and dips of the olden days, and the illumination is imperfect and unsatisfactory. The miners themselves feel that if better light was accorded them, the inspectors could better examine the roofs and walls and protect them from possible cavings and falling material. Capt. S. S. Curry, president of the Metropolitan Iron and Land Company, is now placing incandescent lamps in its mines at distances of 20 feet along the drifts and passages, and will place a sufficient number in the large chambers to supply all the light necessary. A syndicate, of which Mr. Ferdinand Schlesinger, of Milwaukee, is agent, is making great strides in the acquirement of mines in the Menominee range, having already secured three large properties. All these, it is said, are to be electrically lighted in the not very distant future.

The chances are said to be good for Columbus, S. C., obtaining a large industry within her borders. An electric aluminum manufacturing company is considering that city for location.

ELECTRICAL NEWS.

Boston, Chicago and Other Points.

OUR CHICAGO LETTER.

Exposition Fires.—A fire occurred at the Chicago Exposition building on the 14th instant, which very considerably marred the cash account of several insurance companies. The fire occurred from a flying spark disengaged from an arc lamp carbon, which floated into a finely fringed linen towel. The lamp was in an inclosed and locked booth, and before the booth could be opened the flames were well underway. From the original booth it spread so as to partially damage some 14 other booths, and while the loss in the most of these was not extensive, several of them including contents were totally destroyed. The building was almost entirely unharmed. The firemen did splendid work in saving the structure, which is constructed with no upright supports; the roof being an arch sprung from the side walls. The exposition was not suspended in consequence, but was in full blast again on Monday.

The St. Joseph, Mo., Exposition was destroyed on the next evening. The damage there was far in excess of that in Chicago. Fortunately no lives were lost in either case.

Bids for the New Plants.—I gave the REVIEW the specifications of the proposals for the new plants last week. The bids were opened yesterday, as advertised, and there were found to be seven competing bidders. I am able to give you all the figures, which were cheerfully furnished to the city press as soon as the classification of the bids was accomplished. The specifications were of such a nature that no more than the names of the competitors could be furnished the afternoon papers.

A New Battery Again.—Dr. E. D. Cross, of Chicago, has been devoting his energies for 20 years to the study of electricity, and claims to have perfected a system of lighting and power from primary cells which is both perfect and economical. He exhibited it recently, and the spectators were well satisfied that the motive power could be utilized for large or small machines. The *Tribune* says: "Dr. Cross claims to be the possessor of seven patents, all in the nature of improvements in regard to electric light. His chief claim is that he dispenses with the dynamo entirely, the power, whether for lighting or for furnishing the motive power for running an engine, being derived direct from the battery. The battery is of unique construction and is said to be much cheaper in construction and cost of running than any other. He claims also that by the use of hollow carbon tubes he has avoided polarization, and that the batteries can be placed in any room without danger to the occupants. He uses a solution of nitric acid and nitrate of ammonia for the outside shell of the battery, and by conducting the fumes from this product into water neutralizes any bad effects which they might have if given off into the air." C. C. H.

Chicago, September 23, 1889.

OUR BOSTON LETTER.

A Necessary Enlargement.—Mr. Horace E. Swift, who has been doing a large business in the electro-mechanical line at 34 School street, has found it necessary to obtain increased facilities and has removed to 62 Sudbury street. The shop facilities are more than doubled and orders are now in which will last for three months. The firm name is now H. E. Swift and Company, Mr. T. P. Swift having been made a partner.

Japan and Electricity.—The Japanese people are not slow in taking advantage of new and valued improvements and improving opportunities for advancement, as evidenced in the large number of young Japanese who are in the best educational institutions of this country. I hear that a local company, composed entirely of Japanese, has recently taken a contract for 350 incandescent lamps for use in the newly opened parliament, the apparatus and machinery to be furnished in this country. Illustrating the desire of the Japanese to keep up with the times, Mr. H. B. Cram, manager of the Bernstein Electric Company, showed me recently a communication from a Japanese reader of the REVIEW asking for catalogues and other information concerning the Bernstein incandescent lamps for arc circuits.

The Society of Arts.—The meetings of the Society of Arts, Massachusetts Institute of Technology, will be held as usual this year at the Technology buildings, Boylston street, and as the meetings are practically open to anyone interested in the subjects, and are always interesting to those scientifically inclined, they should be more largely taken advantage of by the electrical fraternity. Notice of the meetings will be given from time to time in this column.

The Immense West End Power Station.—The new power house of the West End street railway, which will be erected on the site of the old Hinckley locomotive works, is becoming a reality, as work has been commenced on the foundation. This station, which will supply current for the largest street railway system in the world, will be one of the best equipped stations ever built. Under the supervision of Mr. W. D. Pearson the details of the station are being worked out, and an idea of the problem may be gained from a few facts relating to the equipment. The station will contain, when entirely completed, 13 triple expansion Reynolds-Corliss condensing engines of 1,000 horse-power each, and each driving four generators with a capacity of 185,000 watts each.

A Presentation.—Manager Alexander, of the Lawrence, Mass., Edison station, was presented with a beautiful gold watch, nonmagnetic, by his employés last week. Mr. F. P. Oliver made the presentation speech.

A Reorganization and Increase of Capital.—Mr. H. H. Eustis is now president, and Mr. Henry A. Clark general manager and treasurer, of the Eastern Electric Cable Company, which manufactures the farfamed "Clark" wire. The company has been reorganized with a capital of $300,000, to extend its business and increase its facilities. $186,000 is in preferred stock, on which a guarantee of six per cent. interest is made. Manager Clark told me some time ago they were running night and day and couldn't keep up with orders, and that something would have to be done. The something has now been done, and we may expect the Clark wires and gums to take an even more prominent place among the users of reliable and high quality insulated wires.

Examining Applicants.—Announcement is made of the following examinations to be held by the examining boards of the New England Electric Exchange, for certificates of proficiency to those operating or installing electric light and power plants: At New Haven, Conn., Sept. 25th; Waterville, Me., same day; Springfield, Mass., Oct. 2d; Rutland, Vt., same day.

Boston, Sept. 21, 1889. T. W. S.

OUR WASHINGTON LETTER.

Cable Cars.—The Washington & Georgetown R. R. Co. have begun active operations on their Seventh street line. The iron yokes for the cable conduit are laid at intervals on the sidewalk, ready to be put in place as soon as they are reached by the excavations. It will be an easy matter to convert the road into an electric road on the conduit system, should the company decide at any future time to do so.

Delayed Trials.—The Brightwood R. R. Co. were unable to make the trials of the storage battery, as was comtemplated last week. The reason is that the car has not yet arrived. Their president, Capt. Thomas, states that he has heard nothing as yet from the builders. He is of the opinion that the overhead system is the best, but prefers the storage battery for the reason that a breakdown and paralyzation of the whole line is impossible in that system.

The Gas Co. et al. vs. Commissioners et al.—The suits of the Washington Gaslight Co. and Cammack and others, against the Commissioners of the District and the electric heat and power company, of Pittsburgh, was up before Chief Justice Bingham this week. No material new points were developed. The attorney for the prosecution made the rather unique point that since the light was produced by the resistance of carbon points to the electric current, they could not be regarded as illuminating material, and illuminating material was specifically called for in the act. It was urged for the defense, and very properly, that electricity was as much an illuminating material as hydrogen. The gas company appear to be in a bad way on the contract question, as no contract appears to have been made with them. But they, however, never to be outdone, claim that the contract is statutory. In other words, that Congress in making an appropriation for gas lighting virtually made a contract with them, since they were the only venders of gas in the territory to be lighted. A number of the citizens have taken a hand, claiming that where municipal authorities are about to pay out the funds of the municipality in any illegal way, any taxpayer, for himself and others, may have the proposed illegal expenditure enjoined by a proceeding in equity. This is met by the claim of the defense that "there is no allegation of fraud or of illegal burden, or of increase of taxation," and that "the taxpayer could come in only when his burden of taxation is increased, or when there is a threat to that effect."

Later Developments.—The Chief Justice of the Supreme Court of the District has granted a preliminary injunction against the commissioners and the Electric Heat and Power Co. restraining them from fulfilling a contract for lighting the streets by electricity. The injunction, while virtually a victory for the gas company, was granted in response to a showing made by Cammach *et al.* mentioned above. The bill of the gas company was dismissed on account of their lack of standing in court. The case will be appealed to the court in General Term, and perhaps on to the Supreme Court. In that case we shall have a decisive answer to several knotty points as to the operation of the act of Congress relating to light and wiring in the district.

New Plant.—The Schuyler Co. has been erecting an arc light plant of 65 lights for lighting the town of Alexandria, Va. The work was completed and the current turned on a few nights ago. Everything is working smoothly and the citizens are loud in the praises of Councilmen Marbury, Fisher and Strider, to whose energy and foresight they are indebted for this great improvement.

Another Worker in the Field.—The New South has taken another step towards that crown of glory and prosperity, that is to be her recompense for the cross that she has borne so long. A number of Northern capitalists have obtained a charter of incorporation under the title of "American Electrical Supply and Appliance Company." Their name indicates their object, viz: the manufacture of electrical appliances. There will be 5,000 shares of stock at $100. The location of the company is Alexandria Va.

Washington, D. C., Sept. 20, 1889. G. E. M.

The Government Takes Possession of the Entire Telephone System in France.

The charter which the "Societe Generale des Telephones" obtained from the Minister of Industry and Commerce, in 1884, contains a clause whereby the Government is authorized to acquire, at any time it deems fit, the rights, privileges and property of the company, in return for the payment of an indemnity, the amount of which is to be fixed either by mutual agreement, or, in case of dispute, by experts. In June last the Chamber of Deputies, in compliance with a request on the part of the Prime Minister, M. Tirard, voted a sum of $2,000,000 for the purpose of enabling the Government to acquire the telephone system, and a few days later the Premier addressed a letter to the president of the company, wherein he notified him that the charter would be withdrawn on September 1st. At the same time M. Tirard requested the "Societe Generale des Telephones" to declare the amount at which it estimated the value of its lines and material, stating that, in case of any difference of opinion on the subject between the company and the Government, experts would at once be appointed to arbitrate on the points at issue. To this communication the managment of the "Societe Generale des Telephones" replied, refusing to give any information as to the value of its material, and contesting the right of the Government to annul its charter. Nothing further was done in the matter until August 13th, when M. Jousselin, an electrical expert, was appointed by the Prefect of the Seine to obtain an inventory of the material of the company and to estimate its value. The management, however, refused either to furnish M. Jousselin with an inventory, or to give him any facilities for compiling one. On August 21st the Prime Minister addressed a further letter to the president of the company, repeating the request contained in his former communication, and on receipt of a negative, and even discourteous reply, dispatched a final appeal to the management on August 24th, which was allowed to remain without acknowledgment whatsoever. Under the circumstances, therefore, the Government felt that it had done all that lay in its power to come to a friendly understanding, and accordingly issued orders to the Department of Posts and Telegraphs to seize the property of the telephone company throughout France on the morning of September 1st, at the same time sending instructions to the Prefects and Sub-Prefects of the various Departments to provide for armed force in case of any resistance on the part of the company's officials.

The proceedings in connection with the seizure passed off without any disturbance, the only arrest made being that of the artist of a comic paper, who was detected in the act of caricaturing the very stout Commissary of Police appointed to superintend the taking possession of the telephone offices on the Place de l'Opera, in this city. Of course the Societe Generale des Telephones is loud and violent in its denunciations of the action of the Government, which it describes as being nothing less than a shameless robbery, and it has already commenced legal proceedings in the matter with the object of securing not only the cost value of the material which it owned, but also a heavy indemnity for the loss of so lucrative a monopoly. There is little chance, however, that its wishes in the matter will receive any satisfaction. Meanwhile the telephone service continues without a single break or interruption.

Electric Welding Profitable.

The Thomson Electric Welding Company has sent out this circular recently, offering a valuable right to shareholders:

At the stockholders' meeting held at Portland, Me., on the 6th day of September, 1889, the capital stock of the company was increased from $500,000 to $1,000,000. The following vote was also passed:

"Voted, that the new stock above authorized be disposed of from time to time in such amounts and upon such terms as the directors may determine, preference in the opportunity to subscribe for the same being given in each case to stockholders of the company."

Pursuant to a vote of the directors September 7, 1889, subscriptions will be received from stockholders of record September 14, 1889, each stockholder being entitled to subscribe at par for one new share for every share of the old stock held by him on that date.

If you desire to subscribe for the portion of said stock to which you are entitled, or any part thereof, please fill out the enclosed form of subscription and mail the same to the office of the company, No. 89 State street, Boston, Mass., so that it will be received on or before September 20, 1889, after which date no subscriptions will be received.

The first payment of $25 per share will be due and payable at the office of the company aforesaid, September 20, 1889; the remaining $75 per share at such times as it may be called for.

Receipts will be given for above payment, exchangeable for certificates as soon as prepared.

Any stock not subscribed for and payment made thereon according to this notice, will be sold at the discretion of the directors.

Inclosed herewith you will find a form of assignment of your rights, or any of them.

By vote of the directors, the transfer books of the company will be closed from the 18th to the 20th day of September, 1889, both days inclusive

The amount of stock hereby offered is 4,602 shares, the same being equal to the amount of stock already issued, 398 shares of the old stock still remaining in the treasury. The amount of stock unissued in the treasury after the new subscription is closed will be 796 shares. B. F. SPINNEY, Treasurer.

The Thomson Electric Welding Company sent with the above subscription privilege a circular relating to the present state of welding by electricity; also a circular reviewing briefly what the company has accomplished. This last circular says, in substance, that the company was organized in April, 1888, but did not really get to work until the new factory was completed in February, 1889. When the company was formed but two machines were in operation. These machines were only experimental, and had to be superseded by others, and many additions and improvements have been made. The aim has been to furnish perfect machines, and no machine sent out has failed to do its work properly. Orders have increased rapidly, and the company has 70 machines in operation or under construction. The circular, which is signed by President William F. Draper and Treasurer B. F. Spinney, further says:

"The developments made in the direction of perfecting our machines will be illustrated from the fact that, in addition to the five foundations patents purchased from Prof. Thomson when the company was organized, we have already taken out 24 patents, and have 25 more for which we have made application, some of which are already allowed, and the others are in process. Our machines are all leased, subject to a continuing royalty per weld, and those who have ordered them and adopted the process are without hesitation signing these leases and agreeing to the royalties demanded. Our sales of apparatus thus far have been made from our office, solely through the efforts of Mr. Royce, our general manager, and we have neither employed agents nor have we paid commissions on any sales whatever. Many types of machines have now, however, been decided upon, and correspondence from various parts of the country shows that there will be a very active demand for our apparatus. Our new factory building covers an area of 25,000 square feet, and is supplied with the necessary machinery and suitable instruments for rapidly developing the welding process and for building machines for the market. In view of this, the company has determined to employ suitable salesmen at once, who will, as soon as possible, cover the country thoroughly, and place the machines in general use. When it is remembered that the business of this company has been the development of an entirely new art, the progress already made, and the outlook for its future interests seem very encouraging, experience thus far having fully confirmed our early confidence in the value of the invention."

PERSONAL.

E. T. Gilliland, president of the Electric Club, has just returned from Europe where he has been looking after his extensive nonmagnetic watch manufacturing interests at Geneva.

The firm of C. & H. Russell has completed arrangements with the Westinghouse Company of Pittsburgh for the establishment of an electric light plant at Seneca Mills, Pa., for the lighting of the village.

Mr. Brainard Rorison, of Indianapolis, has accepted the position of assistant manager of the Ft. Wayne Electric Company, the Indianapolis Jenney Company having been purchased by the Ft. Wayne Company. Mr. Rorison will make his home in Ft. Wayne, and will be a valuable addition to General Manager McDonald's staff.

Telephonic News

⁂ Two companies are seeking telephone franchises at Port Townsend, W. T.

⁂ Troy, Ala., will have electric lights and a telephone exchange in a few weeks.

⁂ The telephone office building in Milwaukee, Wis., is to be enlarged by building up the rear part to four stories.

⁂ A new telephone company has been organized in the city of Mexico. The rates for service will be lower than those now in force.

⁂ By a fire in the Yale Bank building at New Haven recently, the telephone system was badly interfered with and rendered practically useless for a time.

⁂ The Cleveland Telephone Company is putting its wires underground and, according to Manager McKinstry, will have buried 300 miles of wire before snow flies.

⁂ The re-building of the New England Telephone and Telegraph Company's line from Fitchburg, Mass., to North Adams is completed with the exception of a stretch between Athol and Erving.

⁂ The American Telephone and Telegraph Company, so it is reported in Omaha, will build a line between that city and Chicago. The latter city will, it is said, be connected with St. Paul and Kansas City, also.

⁂ For some time there have been four of the wires of American Telegraph and Telephone Company running into Waterbury, Conn., on a loop from Birmingham. The capacity of the service has been increased by two more wires now, the laying of which a gang of 10 men under foreman Ford has just completed to the central office. These six wires are now all connected with the main line which runs from Boston to Washington.

⁂ It is possible that there may be a meeting of Mexican telephone shareholders to listen to a statement of the condition of the company's affairs in Mexico from Mr. John Crawford, of Reading, Pa., who was sent to Mexico last April under a contract with the Mexican Telephone Company as general manager, but whose contract has, it is said, been repudiated by the new board of directors chosen soon after Mr. Crawford arrived in Mexico. The gentleman is now in the United States, and his observations in Mexico would undoubtedly interest shareholders of the telephone company.

⁂ Large gangs of men worked continuously day and night repairing the telephone exchange at New Haven, Conn., recently damaged by fire. The New Haven *Register* shows its appreciation of the telephone by the following from its editorial columns: "The loss of the telephone for several days this week has impressed upon people the fact that the telephone has become one of the chief necessaries of life. However much we may feel disposed to find fault with the service and swear at the operator, we acknowledge at such times as these how great an institution is this of which we are now deprived. It has become so necessary to newspaper men and business men generally that its loss is like being deprived of one of the seven senses."

⁂ In Cookeville, Jackson county, Tenn., there is some excitement over the persistent wanton destruction of the telephone line about half way between Bloomington and Gainesboro. First, according to report, certain parties got to cutting the line, pretending to be afraid of lightning. This was arranged, however, by the man who was afraid moving it away from near his house through his orchard. Next, a road overseer and his hands, it is said, wantonly cut a number of trees on the line, ruining it for several miles. It is down now, cut in several places in the woods, away from anybody's house. A large quantity of the wire has been stolen, it taking about a half mile of wire to repair the line.

Extension of the American Electrical Works—A New Factory in Montreal.

One of the most striking proofs of the great demand for all kinds of electrical wire and conductors generally, as well as an instance of the success which a painstaking firm can achieve, is shown in the fact that the American Electrical Works, of Providence, R. I., have been compelled to extend their facilities again and again in the past, and have once more added by locating an entirely new and independent offshoot in Canada. The E. F. Phillips Electrical Works, limited, was organized this month in Montreal with a capital of $60,000, and starts out with the following efficient corps: E. F. Phillips, of Providence, president; E. A. Smith, of Providence, vice-president; James Cooper, of Montreal, secretary and treasurer, and Frank S. Mead, electrician and general manager.

Mr. Mead has been assistant to Mr. Sawyer, of the parent works, for ten years past, and is thoroughly fitted for handling the reins. He has been in Montreal since last April, and has fitted up a new factory with machinery and tools sent from the Providence works. The new factory is 100 feet by 45 feet, four stories high, brand new, and one of the best in Montreal. It is practically the branching out into Canada of an old established works, and no experimental stage is to be gone through; hence, right from the start, the new works should and will turn out just as good work as the parent works in Providence. The new concern has our best wishes.

The Telegraphophone.

A little trouble has been experienced in the use of the telephone by frequently being unable to find the other man at his end of the wire, and often waiting a long time to catch him or to have "Central" do it for you, repeatedly finding that he fails to reply. This difficulty has been partly overcome by a new instrument called the telegraphophone, the inventor of which is Mr. M. Wheless, of Nashville, Tenn. He claims that his invention is an improvement on the graphophone whereby the indentations on the cylinder of that instrument can be reproduced on another cylinder, and that the vocal sounds represented by the indentations are made audible. The instrument works after this fashion: There are two metallic arms on the bar of the graphophone insulated from the bar and from each other. One of these arms carries a stylus on one side at the end, and on the opposite face a carbon contact. The other arm has a metallic point resting upon the carbon contact, and on the opposite face is a metallic point resting against a piece of well-stretched gold-beater's skin, to which diaphragm there is secured a pipe having an earpiece at the end. Also secured to the bar of the graphophone there is another piece of metal, carrying an annulus and a metal diaphragm, upon which is placed the usual mouthpiece. There is a closed primary circuit on each graphophone, regulated by a switch, the circuit when not in use being kept open. To use the instrument the graphophones are set in motion and the message is spoken through the mouthpiece against the diaphragm of the transmitter, the indentations being made on the sending cylinder by means of the stylus, and as they pass from this they come in contact with the second stylus, which takes up the vibrations and transmits them to the carbon point. The current passing over the line actuates the electro-magnet close to the metal diaphragm at the receiving station, and the result is the receiving cylinder is indented by its stylus reproducing the disturbances on the diaphragm, which are, of course, duplicates of those on the sending cylinder. The disturbance which these indentations cause to the diaphragm of gold-beater's skin makes the sounds which will be heard should this attachment be adopted. Upon entering a room one can not only be made aware that he has been called upon by telephone, but by setting the little machine in motion he can find out exactly what was the object of the call, and should the other party not be there to receive his reply, the message can be sent and recorded to await his return.

The St. Louis Exposition.

The St. Louis *Globe-Democrat* has the following account of the electrical displays at the Exposition in that city: "Those who have not yet attended the Exposition can form no idea whatever of the wonderful ways to which electricity has been brought under the control of man. All the varieties of forked, zigzag and sheet lightning have been harnessed, as it were, and made to dazzle and sparkle in complete submission around the motors and powerful dynamos. There is no greater surprise in the electrical department than that found in the display of the Excelsior Electric Company, of New York, showing arc and incandescent lamps and motors. Mr. Randolph, of the Chicago office, has put in the exhibit, and, as is characteristic of all residents of that windy city, he is not in need of a single breath of air to assist him in tooting his own horn, loud and long. The booth is prettily decorated with pink trimmings, the ceiling being covered with white China silk. The remarkable way in which electricity is utilized is seen here by a single current from a 25-horse-power generator being made to run a 10 horse-power motor, this in turn running a 100 light incandescent motor, the same current then being transmitted to a one one-horse incandescent motor and one three-horse motor. From the same generator a current is procured which runs a seven horse-power motor, which, in turn, runs a five light arc machine with 200 candle power. This is said to be the absolute fact, even after all the usual allowances for a Chicago story, and it is an admirable illustration of the transmission and retransmission of electric power.

"Another novel exhibition of the most common, practical every-day use to which electricity can be applied is at Dr. Burton's display of electric heating apparatuses. Heaters are made for railway coaches, houses and all places where artificial heat is used. But the cooking apparatus attracts the most attention. The scientific explanation is very simple. Small iron pans are placed over a network of electric wires, which, by being covered with fire clay, will stand any current without infusion or the slignest evidence of melting. The electric current is, therefore, turned on so strong that any degree of heat desired is obtainable. By a simple contrivance the current can be lessened or strengthened, and the heat consequently regulated. Coffee is made to the most delicious flavor of the Mocha or Java brand, and dispensed without charge to spectators.

"The electrical piano in the Bollman Bros.' display on the main floor is an object of wonder and admiration. The current of electricity is furnished from below, and by the use of large sheets of perforated paper the piano is made to play the most exquisite pieces of the old masters without the aid of human hands. The current of electricity can be thus furnished to any residence and attached to a piano of this make, and the residents of the neighborhood be relieved of the exasperating thumping and soul-harassing discords of some young lady who is a tyro with the keys. Good music can be enjoyed at the start. To the shades with Rosenthal Sherwood."

The Electric City.

Cleveland, says the *Plain Dealer*, has a reputation throughout the country of being the electric city of the West. Manufacturing and electrical magazines refer to it in that light. Since the equipment of the East Cleveland road with 16 motor cars nine months ago there have been ordered 60 more of increased motor power. The Brooklyn line is also adding to its stock of motors as fast as possible and by the end of this month expects to have 42. The Broadway line will in two months have from 10 to 20, which makes a total of about 122 motors in the city. Cleveland in street railway matters is very energetic and leads all other cities. The objections once raised to rapid transit have been combated.

⁂ Manager W. H. Fairchild, of the Manchester, N. H., telephone exchange, is taking active measures to prevent the excessive use of the lines by non-subscribers.

A New Company in Detroit.

The Detroit Electric Light and Power Company has just been incorporated with a capital of $300,000, and will compete for the public lighting of the city. The stockholders in the new company comprise the principal stockholders of the Commercial Electric Company, of Detroit. William B. Moran is president of the new company; Gilbert W. Lee, vice-president; Joseph B. Moore, treasurer, and W. H. Fitzgerald, secretary. Mr. R. T. McDonald, president of the Fort Wayne Jenney Company, whose system will be used, is a large stockholder, individually and in trust.

Electric Power in the South.

(From the *Manufacturers' Record.*)

The South must have the best of everything that will lend to its economic industrial development, and there is no one thing that can lend more to this economic development than electricity. This marvelous force is the most mobile, convenient and economical agency for the distribution of energy in the industrial world. It has all the virtues of both steam and water, without the accompanying bulkiness, smoke, dust or noise, and there is nothing in it to explode or give away. It can be used on the spot where it is generated, or it can be transported 20 miles or more. Most important of all to a busy community, with its numerous small industries, it costs much less than an equal capacity of steam. An important factor in this economy is that electricity, unlike steam, can be used over and over, so to speak, the same as water can in a mountain stream. We have in mind a certain electric station, with a two-mile circuit. The capacity of the plant is 500 horse-power. The loss of power in the conductors, generators and motors is about 30 per cent., yet the customers on the circuit use 700 horse-power.

The two important uses for electricity in the development of the South are in mining and in supplying power for many small industries, as in the case of the two mile circuit just mentioned. Few people are aware of the great advantage of electricity over steam or compressed air in mining, and as mining is one of the coming great industries of the South, it is necessary that we should understand all about these practical uses of electricity.

Electricity is used for hauling, hoisting, drilling, pumping, ventilating and many other kinds of work. And oftentimes it can be generated by unused water-power at hand or near by, instead of by steam power. In hauling minerals electricity has proved much more convenient than horses, mules or steam. Careful estimates place the cost of electric power from 20 to 40 per cent. less than mule power, and at the same time it is more speedy and safe. Electric hoists are most easily handled, and do away with the great length of cables often so necessary. For drilling purposes electricity is claimed to have advantage over compressed air. All that is necessary is to move the wire and the motor, and there is no introduction of dampness and no constant repairing of parts. In pumping out mines by steam it is necessary either to carry steam long distances in pipes to the pumps on the several levels, or to rely upon the working beam method. In either case, the advantages are greatly in favor of electric pumps, which can be placed in any position or location by simply extending the wire. Ventilation is simplified over the usually adopted methods by having numerous fans and blowers run by electric power. This power, too, can be used in all above-ground processes, such as operating railways, running stamp mills, machine shops, etc. And the power necessary in all these various operations can be generated from one central station, instead of being cut up into several, as is commonly the case now. There need be no expensive plants of powerful engines, with their costly array of shafting, pulleys, beltings, long lines of steam piping, compressed air tubing, etc.

A practical person will see at a glance from these statements that electricity is the coming power in mining operations, both on account of its great adaptability for all purposes, and on account of its cheapness over all other kinds of power.

Electro-Magnetic Separation of Gold.

If gold were a magnetic metal, the work of the miner would be much facilitated, as by means of electro-magnetic appliances the precious metal could be readily separated from the gangue without the use of mercury. But it does not follow that electricity is powerless to assist the gold miner simply because gold is not magnetic. The resources of the electrician are manifold. He is the modern thaumaturgist; and there are few physical problems for which he cannot find a solution somewhere within the realm of the subtle force that is at his disposal.

The accompanying illustrations represent an apparatus by means of which gold may virtually be rendered magnetic, and thus capable of extraction by electro-magnetic devices. Fig. 1 is a front elevation, Fig. 2 a

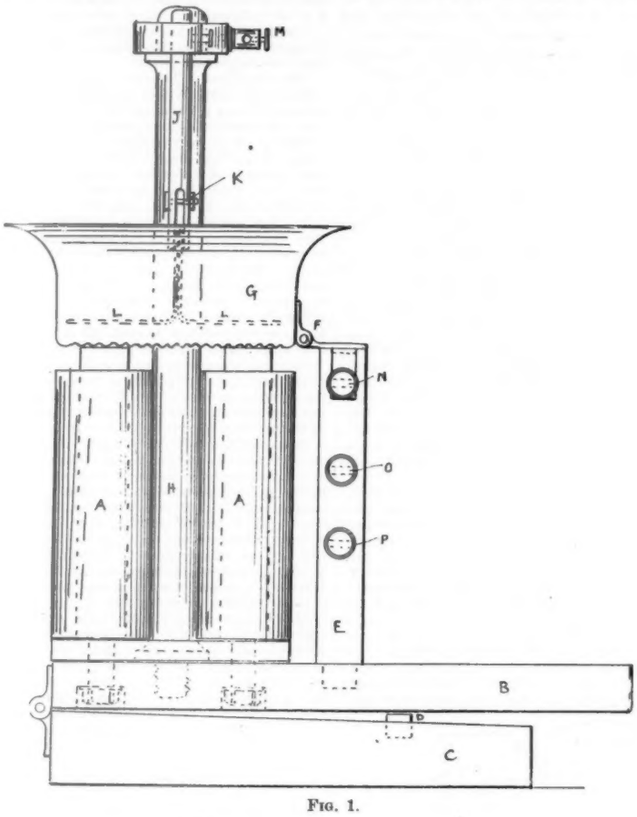


FIG. 1.

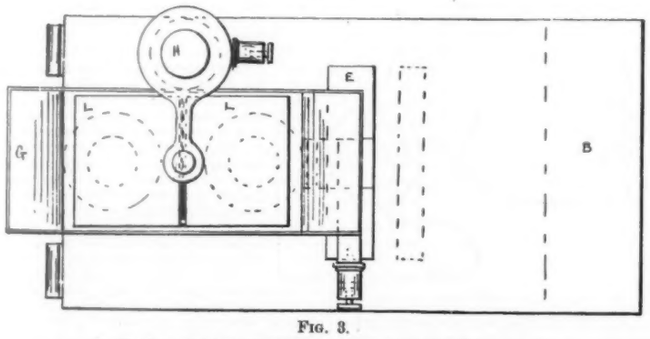


FIG. 3.

S. H. EMMENS'S ELECTRO-MAGNETIC SEPARATION OF GOLD.

side elevation, and Fig. 3 a plan. The apparatus consists of an electro-magnet *A A* fixed on a wooden base *B*, which is hinged to a beveled bed plate *C* and is supported in a horizontal position by a rubber cushion *D*. A wooden upright *E*, also fixed to the base, carries a hinge *F* connected to a rectangular copper vessel *G*, so placed that it rests on the poles of the magnet. A second wooden upright *H* carries a projecting metallic arm *I*, which holds a metallic rod *J*, terminating in a clamp *K*, by means of which two bent sheet iron plates *L L* are supported within the vessel *G*. The terminals *M N* enable *L L* and *G* to be connected with the positive and negative poles respectively of a battery or dynamo, and the terminals *O P* in like manner serve for placing the electro-magnet in circuit.

The working of the apparatus is as follows: The gold-containing mineral finely pulverized is placed in the vessel *G*, which is then nearly filled with an aqueous solution of ferrous sulphate and ammonium chloride. An electrolytic bath is thus formed in which, when the electric connections with a battery or dynamo are duly made, the plates *L L* constitute the anode and the vessel *G* the cathode. The electro-magnet is then excited and the projecting portion of the base *B* is struck sharply with the hand. The vibration causes the particles of metallic gold to sink to the bottom of the vessel, and immediately they come into contact with the same they become *electro-plated with iron*, and are then capable of being attracted by the magnet. When this process has continued a sufficient length of time the bath is thrown out of circuit, and the base *B* is tilted so as to pour out the whole of the contents of the bath except the iron-plated particles of gold which are retained by the action of the magnet. After this the magnet is thrown out of circuit and the vessel *G* is tilted so as to discharge the iron-plated particles into any suitable receptacle. The gold may then be cleaned by the addition of a little diluted hydrochloric acid which dissolves the iron plating.

The apparatus here described was invented and constructed in 1886 by Dr. Stephen H. Emmens for the purpose of separating the gold, silver and platinum particles contained in the sweepings of jewelers' establishments. For operating on a large scale, as in mining, Dr. Emmens constructed two modified forms of the apparatus. In one of them the cathode of the bath consisted of the poles of the magnet which projected into the bath and were caused to revolve in opposite directions, each on its own axis, while the anode was an iron plate held with its lower edge in the angle between the two horizontal poles. The iron-plated particles were carried over by the poles and fell into outer compartments away from the gangue. In the other of the modified forms the cathodes were bars of iron arranged as a gridiron on the surface of an inclined table and connected alternately with the two poles of a magnet. As the ore and electrolyte flowed over these riffles, the gold particles became plated with iron and remained adhering to the iron bars while the gangue passed away.

.... Spokane Falls, W. T., is about deciding on an electric fire alarm system.

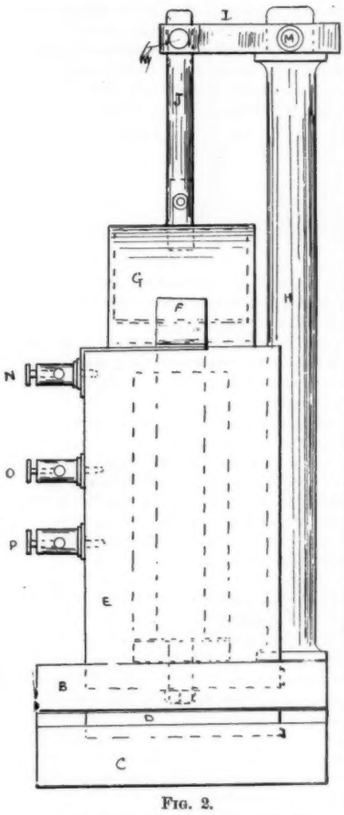


FIG. 2.

.... Mr. Alfred C. Forshawe, superintendent Direct Cable Co., of London, has been in this city during the past week on important cable matters. Mr. Forshawe is well-known in the cable field on both sides of the water, and like Superintendent Brown, at this end of the line, is thoroughly equipped on such business.

.... A telegram announces the death in Washington, D. C., of John W. Lane, a millionaire of Portland, Me. Mr. Lane was formally of the Portland firm of Tyler, Rice & Co., and was interested in the telegraph business with Thos. T. Eckert before the formation of the Western Union Telegraph Company.

.... The announcement is made that the Postal Telegraph Company has opened its office at Columbia, S. C., for business. The new line is composed of two No. 12 copper and two iron wires, gauge six and eight, and is built along the public roads through the country. The entire construction and equipment is excellent. Within the next 30 days the Postal offices at Augusta, Atlanta, Birmingham and other southern points will be opened, and it is confidently expected that by December 1 communication through to New Orleans will have been established. Meantime loops to all the principal smaller towns are being rapidly built.

Hastings, Neb.—The South Sioux City Electric Motor company has filed articles of incorporation with the Secretary of State. The capital stock is $200,000.

TELEGRAPHIC

.... It is stated that Western Union has bought the Port Royal and Western Carolina Telegraph Company's plant.

.... Mr. A. V. Johnson, of Nashville, Tenn., has been transferred to the Western Union office at Sheffield, Ala.

.... The Western Union stock books will remain closed until October 10th, to cover the annual meeting, October 9th.

.... Salt Lake City, Utah, has adopted the Gaynor system of fire alarm apparatus which will be installed throughout the city.

.... The Northern Pacific Railway Company is constructing a telegraph line from Carberry, Man., to Brandon. The work is being pushed.

.... Preparations have been nearly completed for the construction of a telegraph line from Pau Ting Foo, near Pekin, through Shansi to connect with the Russian telegraph system.

.... Superintendent Miles, of Washington, D. C., telegraph and telephone service, has made a report favoring the spread of the Gamewell patrol system, which is already largely used there.

.... George A. Mudgett, a Vermonter, now of New York city, is perfecting an electric signal for railway use. It is said to be as efficacious as the block system of the Pennsylvania railway, but is not nearly as costly.

... Columbia (S. C.) business men and newspaper correspondents are congratulating themselves on the increased telegraphic facilities obtained by the establishment of the lines of the Postal Telegraph Cable Company through the South.

.... The Western Union Telegraph Company prosecuted R. H. Nicol before the directors of the Merchants' Exchange at St. Louis, on charges of furnishing Chicago quotations obtained on the floor of the Exchange to the bucket-shops down stairs, and to Schroeder & Co. of Kansas City. The charges were not proven, the directors said, in dismissing the case.

.... It is intimated around Wall street that a good deal of progress has been quietly made lately toward getting Western Union Telegraph stock listed upon the London Stock Exchange. This has long been one of the pet ambitions of Mr. Gould and Russell Sage, and its accomplishment will mean much in a financial, or at least a speculative, way for the company's stockholders.

.... A despatch from Sioux City, Ia., says: "W. L. McMaster, a telegraph operator, has been arrested here. He has been travelling all over the country, is well dressed and is a good talker. He called on the managers of the Western Union offices in each city representing himself to be the assistant manager of the company's office at St. Louis. He secured loans in every instance, giving orders on the office in St. Louis and signing the assistant manager's name to the orders. He has gathered up a large amount of 'stuff.' He is now in jail, and will be held awaiting developments."

.... The Western Union Telegraph Company, owing to a very heavy increase of business at Portland, Ore., have been compelled to seek quarters other than the ones they now occupy. The company has leased the entire upper and one-half of the ground floor of the new building which is about completed on First street, and expect to move in about October 1. An idea of the increase of business may be formed when it is known that six years ago the Western Union's force of operators consisted of nine men, while now it takes 26 experienced men to handle the business passing through the Portland office.

ALTERNATING CURRENT MOTORS.

(*Continued from page 3.*)

synchronism. It has to go to the double speed or the quadruple, or else at the single speed at which it is synchronous.

Mr. Mailloux: I do not think that Lieut. Patten has made quite clear the reason that would tend to inhibit the racing tendency, or in other words the influence at work to maintain the speed constant when the load is increased or decreased—the exact action which takes place by which the torque is changed.

Lieut. Patten: The action of this machine is not different from that of an ordinary alternating current motor where its maximum electro-motive force is exerted when it is in synchronism within a quarter period of that of the generator. If it is overloaded beyond that point it comes to a state of rest or short-circuits the armature—burns it up.

Mr. Edward P. Thompson: The question has occurred to me—perhaps I could trace it out by means of the diagrams, but I will save that time by asking, what kind of a current would be produced in the outside circuit if the armature were rotated, and whether this new type of motor is also a dynamo, and what kind of current would be generated by it?

Lieut. Patten: I have never driven the machine backwards, but I discussed this question with Mr. Seely in the patent office, and it was first supposed by him that the machine was not a "dynamo and electric motor," as I had termed it in the specification. But we finally came to the conclusion that it was. The chief objection is that a self-exciting dynamo must have a continuous current to excite its field, and must be an increasing current. The unfortunate thing about this machine is that it has not an increasing current. The question arises as to whether there would be a sufficient continuity of current in the machine with this shunt circuit to make it a dynamo. I have not driven it backwards, and the theoretical result can be arrived at as readily by my associate as by myself. I think it would be a dynamo; one of small efficiency, however.

Mr. Leonard: I should like to ask Lieut. Patten if he would kindly give us some description of the performance and sizes of the machines that he has made thus far.

Lieut. Patten: Those I have made are too small to give any data which would indicate any efficiency worth talking about.

Mr. Leonard: What voltage did you work upon?

Lieut. Patten: One hundred.

The Chairman: There are several points in this discussion which should be elucidated, and if any gentleman has questions to ask, or theories to ventilate, or ingenious motors of his own to describe, I trust he will have no reluctance in doing so. There are several gentlemen here whom we all know to be interested in the subject. I do not think that they should make it requisite for me to call upon them. We would be very glad to hear from them and although some of them are here with us for the first time, I do not think they need have any hesitancy in letting us hear from them.

Lieut. Patten: In the meantime I will draw the Mordey machine on the board and show the difference. (Fig. 8 was placed on the board.) The device for rectification is fixed on the spindle of the moving machine. The dotted line represents the spindle of the machine. It is the commutator of an ordinary armature which is shown here (*C*). This being the armature circuit, we will trace it simply as a closed coil (*A*) from the upper point to the opposite point of the commutator, and thence to the field. On the same spindle with this armature is placed another commutator, which is shown here in two parts. The upper and lower halves (C_1 C_2) are separated by isolated segments connected to a rheostat such as I have described this evening. It is shown this way, but in reality there are for each pair of segments a corresponding pair of isolating segments connected with the rheostat, so that after the brush passes one segment it connects with the rheostat, and so on. At the bottom is the source of the alternating current.

These terminals go to the two brushes, bearing on the rectifying commutator, which is broken up into alternating segments, part of them connected and part isolated. The live segments are connected alternately to two rings, say, one-half to the segments of one ring, and the other half to the other ring. Bearing on these rings are two brushes used as intermediate connections. Evidently this machine requires a speed of rotation such that the alternating current coming in at these two terminals will be commutated; then a direct current will flow from the brushes, bearing on the continuous rings, and from these brushes we have a direct current through the armature and field in series, back to the outer ring and so returning to the source of the alternating current. This is spoken of by Leblanc as one solution of alternating current motors. It is not an alternating current motor in the strict sense of the word, because the alternating current is commutated before it is put into the machine. It is open to the same objection, of course, that the alternating current is broken at the point where it passes zero value, and the same remark applies to the field.

Mr. W. Forman Collins: When you break

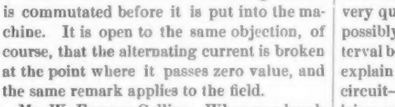


FIG. 7.

the circuit there, the field will lose its magnetism. Will not the armature act as a short circuit across the field?

Lieut. Patten: If the machine is in synchronism, the current at this point is near zero, and the short circuit is then of little consequence.

Mr. Collins: It would induce very heavy sparking, would it not?

Lieut. Patten: It would if it were not for the isolating segments on which the brushes then bear, and which offer a path for the current and so prevent its rupture.

Mr. Collins: Provided the field maintains some little magnetism.

Lieut. Patten: Yes; if it gives it up entirely, of course the reactionary effect would produce sparking.

Mr. Dugald C. Jackson: I should like to ask if all these schemes are not beating around the bush to get a continuous current motor, and if the size of the machine when put on practical circuits is not prohibitive, and that consequently we cannot with any of these schemes get an alternating current motor that will do the work on practical circuits economically.

Lieut. Patten: If we accept the gentleman's remarks as conclusive that would settle the matter. I shall have to refer you to future generations for your answer.

Mr. Charles J. Reed: I would like to ask one more question in regard to the action of these waves. As the potential varies from maximum to zero, suppose you have the normal speed; instead of being in reversal the potential simply rises and falls from maximum to zero. Now, as that occurs at a certain speed, will not the iron completely lose its magnetism each time as the potential falls to zero? I confess I am not posted on the rate of demagnetization of iron, but I am informed that in an ordinary converter the iron will actually become demagnetized something like 20,000 times a minute. I would like to get some information on that. If that is so and you use a current having a less number of reversals than that, would not the magnetism actually become zero between each of those successive impulses or waves? Instead of being a continuous current would not the current actually vary from a certain maximum to actual zero?

Lieut. Patten: I would suggest that you call upon others to answer these questions of general information. I would simply say in reply to that, that so far as my experience is concerned I have seen magnets that change their magnetism as slowly as 15 times a second and retain enough to act as small dynamos; that is very slow as compared with 133 reversals which are used in this country, and down as low as 50 on the other side. But there undoubtedly is an approach to zero in the magnetic field, and there is at the same time a period of zero current in the armature. You can have an iron field that will not give up its magnetism in the one hundred and thirty-third part of a second, and you can have one that will give it up in much less time, and you can have one that will retain it one-fifteenth of a second.

Mr. Reed: Would not your laminated field be an objection, that it would tend to have the magnetism actually become zero at each reversal?

Mr. Mailloux: I think we can throw some light on this point. I do not think that the magnetism would necessarily come to zero, simply because we are not dealing here with a simple magnetic circuit. If we were dealing with a simple magnetic circuit in which there is no reaction against the lines of force in collapsing then you would doubtless get a very quick collapse of the magnetism, and possibly absolute zero of magnetism in the interval between the two pulsations. You might explain this by taking an ordinary magnetic circuit—a ring for instance—with a magnetizing coil, the ring consisting of very finely divided wire. Now, if there is no reaction (Foucault currents, etc.) against the flow of lines of force; if we assume the ring to be fully magnetized and the magnetism suddenly released, and if we even eliminate the self-induction of the magnetizing coil itself, then we will readily see that the magnetism will fall almost instantly. There are experiments which go to show that the fall of magnetism would take place in an inconceivably small space of time under such circumstances. But if we interpose in the path of the lines of force as they move, while rising or falling, a closed circuit or some other form that would tend to produce reaction, then we get what we call "Lenz effects," and in that case we cannot get such a rapid rise and fall. Now, in this machine, the armature itself, the cord and conductors, are in the magnetic circuit; they form a part of it. Consequently at the time the magnetism is falling or rising, there would have to be considered the reaction due to the conductors wound around the magnetic field itself, and also the conductors wound around the armature, and the currents induced in these conductors by either the rise or fall, would necessarily tend to retard both the magnetizing and the demagnetizing process, and I should think that it would be possible to so regulate the self-induction of the different portions of the circuit as to control that. I, at first, thought that the demagnetization would take place very rapidly. I still believe that there will

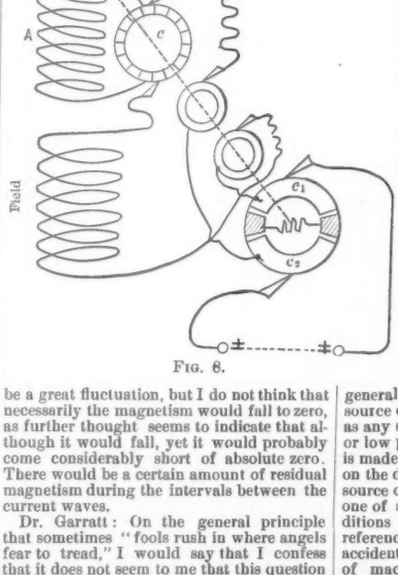


FIG. 8.

be a great fluctuation, but I do not think that necessarily the magnetism would fall to zero, as further thought seems to indicate that although it would fall, yet it would probably come considerably short of absolute zero. There would be a certain amount of residual magnetism during the intervals between the current waves.

Dr. Garratt: On the general principle that sometimes "fools rush in where angels fear to tread," I would say that I confess that it does not seem to me that this question of the fall of magnetism of the field would be such a very serious one, although in this case I am speaking not at all from experience, never having wound a machine of that character. But if I understood the gentleman correctly, the only reason why he laminates his field is to prevent undue heating at the starting of the machine. We have spoken of lamination as though it were a fixed thing. It may mean breaking up the core into two or three pieces, or into a million. I suppose that it would be simply necessary to so proportion the laminations of the field that its magnetization would not fall unduly, and so that in starting the machine, the field magnets would not get unduly heated. It seems to me that it could be got at empirically in the natural process of building these machines of various sizes, and that it cannot be got at by pure inductive reasoning; but the natural principle would be that it should be so proportioned that it would not be a practical difficulty.

Mr. E. T. Birdsall: I think one point has been overlooked, and that is the action of different sizes of the machine. In small machines, we know that in breaking the magnetic circuit, the magnet loses its power very quickly. In large machines of 20 or 30 horse power it is known that magnets will not lose their magnetism for from two to three seconds, where the cores are very large and have a large amount of iron in them. In that case, we might arrive at a mean degree of lamination, which would not produce too much heating. We might arrive at a size which would be a mean size of machine, and which would give the best effect. It also struck me, in regard to the magnetism falling, that possibly, although I have not thought it out, it does not matter so much whether the magnetism does fall, because everything else is zero at the same time the magnetism is zero.

The Chairman: There is one gentleman with us this evening who has had considerable experience in the manufacture of converters and also in their use, who I think could enlighten us on two or three of the points which have just been raised, incidentally and directly. I refer to Mr. Gutmann. I think he might favor us with one or two practical remarks on the subject.

Mr. Ludwig Gutmann: I think the motor just described is a very ingenious one, but we cannot discuss the motor itself as it stands alone. We have of course to consider it in connection with the circuit, because we want to transmit power. Synchronous motors generally cannot be thoroughly successful, because they will not answer all purposes. The same speed is not required in all cases. This motor of course is a step forward, because it can be so arranged as to permit the introduction of motors of different speeds on the same circuit. Nevertheless the motor is of the constant speed type, while in practice a variable speed is often desirable. I see one serious objection to the motor, and that is that it has the high potential current in the motor armature itself, and in case of any trouble arising, the consumer who has to handle it, is immediately exposed to the danger of the medium or high-tension current in the main wires. That is the most serious trouble that I find with it. Otherwise I believe it would answer many purposes, because I think the motor will do its work well. It appears the motor would not start from state of rest with any load on it and would need a loose pulley so as to get up to synchronism before the load could be thrown on. This of course would be a weakness, but not objectionable; but the first mentioned objection I think is a serious one—as the machine requires a high potential. I do not think that this motor can be worked with low tension currents, because, especially to produce three or four horse-power or more, the self-induction in those coils in connection with the mass of iron is great. If such a motor should be placed on an ordinary alternating current circuit used here now having about 1,000 to 1,500 volts, and there is any sliding connection and commutators to get loose, or brushes to wear out, we should always have to send practical and experienced men to the spot and they are exposed to the thousand volt currents, and on this ground I do not see that it would quite answer the purpose—I mean that it would not be a solution of the problem, but a decided step in that direction.

Lieut. Patten: With reference to the point of high potential of the machine, of course in the general description I have given, the source of alternating current is represented as any source of alternating current of high or low potential, and so no special reference is made to its use as a high potential machine, on the direct mains from the station. The source of alternating current is presumably one of suitable character to meet the conditions in which it is to be used. With reference to the further difficulty mentioned, accidents will happen with any kind of machine either direct or alternating, while the other forms of motor have some advantages in having ring contacts and sliding brushes that require no attention. The disadvantages that are introduced by bringing in the use of brushes are incident as well to the ordinary forms of motors with which we are familiar. We are not so familiar with the kind that have no commutators that we have got used to their ease and simplicity of working. The second set of brushes are not, as I said before, brushes in the ordinary sense, and do not require adjustment and care. If a high potential machine is used, of course the ordinary precautions will have to be taken. It is not quite within the prov-

ince of the alternating current motor to make the alternating current safe for everybody who uses it.

Mr. Gutmann: I wish to point out that alternating current motors have this drawback, that the coils surrounding the iron core need a certain pressure to make any current flow through those coils—to get any power out of the motor we have to force the current through. Now to produce five or 10 horse-power we need an exciting power, we need a certain number of ampere turns in the field. To have this certain number of ampere turns we must have a considerably higher pressure than might be supposed. We must have an armature to perform the work and to obtain the torque. Consequently I think it is impossible to realize a large amount of power without using medium or high tension currents for alternating current motors. Another point is that we have to consider that alternating current motors will not always be placed in the hands of scientists, but will have to be used by inexperienced men, consequently I think this is a weakness in the motor if we have loose or sliding connections in a high potential circuit. I should prefer to have a motor, for instance, like Prof. Thomson's, in which the high tension current is fixed—no rubbing contact—and I think Mr. Tesla has shown us one way in which to construct a motor without any commutator or brushes, and I believe there are many electricians hard at work to get something similar without a commutator, which is far preferable, but we will have to wait some time before we shall get that. Anyhow Thomson, for instance, has given us a motor in which the field alone is in the high tension circuit. This is the main drawback that I find in this motor. If we had no rubbing contact in these motors, it would be a great advantage. As it stands, the armature is in series, or is in connection with the field, and consequently we have an increased self-induction and we need a greater power and greater tension for this class of motor than we would if we had only to energize one of the two parts, either the armature or the field with the current, and that is the reason I said that there is a serious difficulty in introducing it into ordinary use.

The Chairman: If there is any gentleman here who is not a member, but who wishes to speak, we should be glad to hear from him. I noticed in the course of discussion that the criticism so far on this motor have come from those who are partial to the alternating current motor, and may be said to be working in that field. But it seems to me that there are one or two criticisms or objections to be advanced from the continuous current side of the house, and those objections have been hinted at by one gentleman on my left. With regard to the shape and size and weight of the alternating current motor as compared with others, it seems to me that there are one or two material and pertinent points to be dealt with. Dr. Wheeler perhaps might touch on that. We should also be very glad to hear from Mr. Blake.

Dr. Wheeler: You are very kind, but I have not heard all of the paper and I am not prepared to speak on it.

The Chairman: Haven't you read it?

Dr. Wheeler: I read it hastily. (Laughter.)

The Chairman: There being no other speaker we should be glad to hear from Lieut. Patten in reply and in conclusion, though I think his replies have already been numerous and in most cases almost conclusive.

Lieut. Patten: I think the alternating current motor might be left for the present. In general reply to all it might be said that as to making a rival to the direct current motor, no attempt is made in that direction. The object is not to make a machine which has less weight and more efficiency at the outset than one that has been improved by the ablest talent of the world for the last five or six years. The question is radically whether or not we can make an alternating current motor at all. If we could, the question might be put, what are you going to do with your current 10 miles from here if you cannot get an alternating current motor? I think if the efficiency of such a machine drops to 60 per cent. it would not be a vital question in the problem with reference to the great importance of the transmission of power to great distances.

The Chairman: I am sure it has been a great pleasure to all of us this evening to learn from Lieut. Patten how great and how rapid has been the improvement in the direction of giving us a practical and useful alternating current motor.

I now have much pleasure in announcing that for our October meeting we shall have a paper by Mr. Thomas D. Lockwood, a member of our board of managers, who has recently returned from a prolonged trip through Europe, and has made a great many observations on electrical development there, and who purposes to lay before us the pith of his notes on the subject. The paper will be read on October 8th.

There being no further business before the house, a motion to adjourn is in order.

Adjourned.

Annual Meeting of the Street Railway Association.

The Seventh Annual Meeting of the Street Railway Association, of the State of New York, was held at the Fifth Avenue Hotel, New York City, on Tuesday, September 17, 1889.

The meeting was opened by President Woodworth, with Secretary Richardson at his right. The following delegates were present: John W. McNamara, president, Albany Railway, Albany; Wm. Richardson, president, Atlantic Avenue R. R. Co., Brooklyn; H. M. Thompson, secretary, Brooklyn City R. R. Co., Brooklyn; John N. Partridge, president, and J. L. Heins, superintendent, Brooklyn City and Newtown R. R. Co., Brooklyn; John Hodge, president, Lockport Street R. R. Co., Lockport; M. I. Masson, secretary, Central Crosstown R. R. Co., New York; C. D. Wyman, vice-president, Central Park, N. & E. R. R. R. Co., New York; Geo. Green, president, Forty-second Street and G. Street F. R. R. Co., New York; Edwin Bedell, secretary, Harlem Bridge, M. & F. Railway Co., New York; George S. Hart, president, and Henry E. Doremus, treasurer, Second Avenue R. R. Co., New York; Lewis Lyon, president, Third Avenue R. R. Co., New York; Wm. J. Richardson, secretary, Atlantic Avenue R. R. Co., Brooklyn: Thos. H. McLean, secretary, Twenty-third Street R. R. Co., New York; C. C. Woodworth, secretary, and T. J. Brower, superintendent, Rochester City and Brighton R. R. Co., Rochester; Michael Leary, superintendent, Utica and Mohawk R. R., Utica; E. T. Landon, auditor, Dry Dock, E. B. & B. R. R. Co., New York; Walter G. Howey, superintendent, Grand Street and N. R. R., Brooklyn; John S. Foster, president, and S. M. Sisson, superintendent, Forty-second Street, M. & St. N. Avenue Railway Co., New York; J. Crandall, superintendent, Broadway R. R., Brooklyn; D. B. Hasbrouck, secretary, Houston, West Street, and P. F. R. R. Co.

The president, in his opening address, touching upon the subject of electricity, said: "Great progress has been made in utilizing electric power, and it may be said now that electricians have succeeded in giving us a practical method, so far, at least, as the overhead system is concerned. We note the fact that the West End Railway Company, operating all the lines but one in Boston, and running about 1,000 cars, has secured permission to use the overhead wire, and that they are making preparations to extend this system all over their lines. The success of this scheme will practically decide its usefulness in large cities."

The report of the executive committee, after touching upon the question of "strikes," contained the following: "In the matter of legislation, the companies are especially to be congratulated on the fact that the determination of the question of the substitution of improved motive power has been transferred from the local authorities to the State Board of Railroad Commissioners. This board, having specially to do with the affairs of railroads, is the proper authority to have cognizance of this important subject. The question of motive power for street railways is, doubtless, receiving greater attention than any other single subject."

The treasurer's report showed:

Balance, September 18, 1888	$354 55
Receipts during the year	830 00
	$1,184 55
Expenses during the year	815 49
Balance on hand	$369 06

Mr. John W. McNamara, president of the Albany Railway, had been appointed to prepare a report upon the subject of "An Electric Street Railway Motor." Mr. McNamara was present and apologized for not having prepared the report. He said that if he had been permitted to choose his own subject it was quite likely he would have been able to submit a paper that might be entertaining, if not instructive. It would have embarrassed him, he added, to attempt to make a report on the subject of electricity, for the reason that for more than three years the company with which he was connected had been considering the proposition of using some kind of an electric motor, and he had been busily engaged for the last two years in trying to find out which was best. It could be readily, seen, therefore, that it would be quite impossible for him to submit a report upon the subject, there being such a diversity of opinion concerning such motors. One of the companies in the western part of the State, after a thorough investigation, and after its officers had travelled from Boston to San Francisco and from New Orleans to Montreal, had decided that the Sprague motor was the best in the market, and had equipped their road with it. Another member of the Association, after like investigation, and perhaps travelling even a greater number of miles, had come to the conclusion that the Thomson-Houston motor was the best. The officers of another member had undertaken an equal amount of investigation and travel, and had determined that still a third system was the best; and so it went on until one was utterly at a loss to know which system it was best to adopt. He complained that in his investigation he had not been able to learn much about electric motors from the men who are using them; that there seemed an indisposition to show them up. It was all right when they were on parade; you could get on the cars and ride, but when they came to the power house or storage station, they would rather not have you look at them. On the other hand, companies operating by horses would let you ride on the cars, take you to the stables and car houses, and show you everything; but not so with the happy possessor of an electric motor. As to getting into the machine shop, that was next to impossible.

NEW MAGNETIC VANE AMMETER.

They will show you how splendidly the motor works, but beyond that you cannot get any information.

Mr. Hart, of the Second Avenue Railroad Company, inquired if the systems referred to were not all overhead.

Mr. McNamara answered that they were.

Mr. Woodworth, of the Rochester City and Brighton Railroad, said that his company had built a road five miles long, using the Thomson-Houston system. The system worked very nicely, and gave perfect satisfaction. After the first week there had not been a hitch. The road had been in operation since July, 1889.

Mr. McWhinnie said that the system in use on the Troy and Lansingburgh road was successful beyond all expectation; that the movement of the cars was even, strong and steady. The Sprague system was in use.

Mr. McNamara stated that his road was ready to adopt a system without delay; that since leaving home he had received a telegram that the Common Council of Albany, which had hitherto refused to grant a franchise to the company to erect the necessary poles and other equipment, had at last, by a vote of 15 to 4, granted the desired privilege; and this meant that in the near future the road would be operated by electricity.

Mr. Thompson, of the Brooklyn City Railroad, said that his company was prosecuting thorough investigations in the electrical field, but had not yet arrived at a conclusion as to which system they should adopt.

Mr. Hodge, of the Lockport Street Railroad Company, announced that they also were looking into the subject, and had determined to equip their road with electricity, but were at present unable to decide upon a system.

After the transaction of other business, the delegates repaired to the dining hall for dinner.

The next meeting of the Association will be held in Rochester in September, 1890.

"Magnetic Vane" Ammeters and Voltmeters.

Ammeters and voltmeters which should be at once accurate, permanent in their indications, and cheap, have for a long time been diligently sought for by electricians. In presenting their new "Magnetic Vane" instruments, Queen & Co., of Philadelphia, believe that they have fairly solved this problem and, while not claiming that they have secured absolute perfection, do claim that these instruments have as many desirable features as any others in the market.

This instrument, a cut of which is shown, consists primarily of a coil of wire surrounding two strips of very thin and very soft iron; these strips being as long as the coil is deep and of a width equal to the radius of the space enclosed. One of these vanes is fixed while the other, to which is attached a long thin copper needle, is pivoted in the axis of the coils. When a current passes through the instrument these vanes are magnetized in the same sense and repulsion takes place which is greater or less according to the strength of the current. This repulsive action is counteracted by the tension of a very light coiled spring of non-magnetic metal. By the use of a supplementary piece of soft iron, cut in a peculiar shape and wrapped about the interior circumference of the coil, a nearly proportional scale is secured. The iron which is used, being of the very softest kind and cut exceedingly thin, has very little residual magnetism and no appreciable errors due to this cause are apparent. The pointer and movable vane are very delicately pivoted in caps of polished agate so that there is practically no friction. The instruments are exceedingly well adapted to station or marine plants, as they may be placed equally well in either a horizontal or vertical position or any intermediate angle; they are also very dead beat and give their reading directly. Being entirely free from permanent magnets, they are but little affected by proximity to to dynamo machines. The are also exceedingly compact, being mounted in nicely finished brass cases four or five inches in diameter and about two inches deep, the dimensions varying slightly with the capacity of the instrument.

The instruments are wound either for ammeters or voltmeters; the voltmeters made on this plan, it is claimed, can be wound to a much higher resistance than is ordinarily met with, a fact of the utmost importance to electricians.

They are manufactured to cover a great variety of ranges and in different sizes according to the use to be made of them. The voltmeters ranging from 0 to 10 volts will be found especially valuable for storage battery work; above two volts they are graduated in divisions of $\frac{1}{10}$ volts each. Several large wall sizes are also made for station use.

Electricity and Powder.

The German technical journals have recently published some instructions as to the precautions which ought to be observed in powder mills to prevent explosions attributable to electricity. In a large powder mill in Germany an explosion lately occurred in the press-room. A workman engaged in pressing powder into cakes between sheets of ebonite, left his work during a thunder storm. When the storm was over he loosened the press, and on putting out his hand to remove the powder, a spark four inches long went through his body, igniting the powder and killing the man. The employment of insulating substances, such as gutta percha, ebonite, etc., is therefore considered as liable to lead to accidents. In one of the principle powder mills of Germany the sulphur crushing machines are all put to earth, and since this precaution has been taken there has been no trouble from the mysterious explosions which had previously proven so troublesome.

—— The Duquesne Electric Railway Construction Company, Duquesne, Pa., elected W. J. Hammond, president; J. V. Patton, vice-president; W. J. Hammond, Jr., treasurer; W. J. McElroy, secretary and general manager.

* * The trial trips on the Quincy electric road were very satisfactory.

* * The Council Bluffs Motor Company has just ordered 12 new motor cars.

* * The construction of an electric road between Indianapolis and Irvington is now assured.

* * It is stated that the Watervliet electric road will in a short time be extended to Cohoes, N. Y.

* * The new electric system of the Watervliet road, Troy, N. Y., has been tested with most satisfactory results.

* * The Julien system will be installed at Syracuse, N. Y., so it is reported, on the People's Street Railway.

* * Information is at hand that the street railway of Augusta, Ga., is about to adopt electricity as a motive power.

* * The electric railway company of Des Moines, Iowa, has adopted the Thomson-Houston system of lighting their cars.

* * The Lowell and Dracut Street Railway Company, using the Bentley-Knight system, have received five new box-cars for their electric road.

* * The Daft Electric Power Company are fitting a Sixth avenue, New York, surface car with a new style of motor at their works in New Jersey.

* * It is proposed to string the overhead railway wires on Genessee street, in Utica, N. Y., from the houses and trees, doing away with poles entirely.

* * The city of Canton, O., will soon be equipped with electric street cars, an ordinance granting permission for running them being before the council for final reading and passage.

* * Thousands of people from Troy, N. Y., Cohoes, Waterford and the vicinity, went to Lansingburgh on the opening day last week to ride over the new electric railroad, and the cars were crowded all day. The cars were run at a high rate of speed, and all the trips were successfully made. The general opinion was one of satisfaction at the improved method of propulsion.

* * Milwaukee, Wis., seems to have an electric railway fever. A line is to be built to Wauwatosa, and will probably be in operation in 90 days. This enterprise was determined upon at a recent meeting of the directors of the Milwaukee & Wauwatosa Motor Railway Company. The incorporators of this new company are Rudolph Nunnemacher, Everett A. Smith, W. S. Johnson, A. B. Myers, James Petley, J. B. Dupre and T. H. Rumsey. The officers of the company are: T. H. Rumsey, president; James Petley, vice-president; A. B. Meyers, secretary, and Rudolph Nunnemacher, treasurer. The sum of $200,000 has been subscribed in stock, and this money will be collected immediately, and the work of building the road begun as soon as possible.

* * The new power house at Eau Claire, Wis., in which is to be placed the immense dynamos that are to run the new electric railway, is about completed. The main building is 50 feet square and the wheel house 20 by 40 feet. The whole building rests on a foundation wall laid in cement and seven feet in thickness at the base, which rests on a solid rock foundation. The wheel pit is in a solid rock excavation and is 13 feet deep, its other dimensions being 18 by 20 feet. In this pit will be set two ponderous turbine wheels of 500 horse-power each. Three solid stone piers seven feet square at the base are provided as a rest for the immense dynamos. Besides running the street car lines, some of the power will be utilized for lighting the city and the rest used for manufacturing purposes.

* * The North Attleboro' Steam and Electric Company will supply current for the street railway until the generating plant is completed.

* * The West Indianapolis, Ind., Electric Railway Company has been granted a franchise for 20 years. Road must be in operation by Jan. 1, 1890.

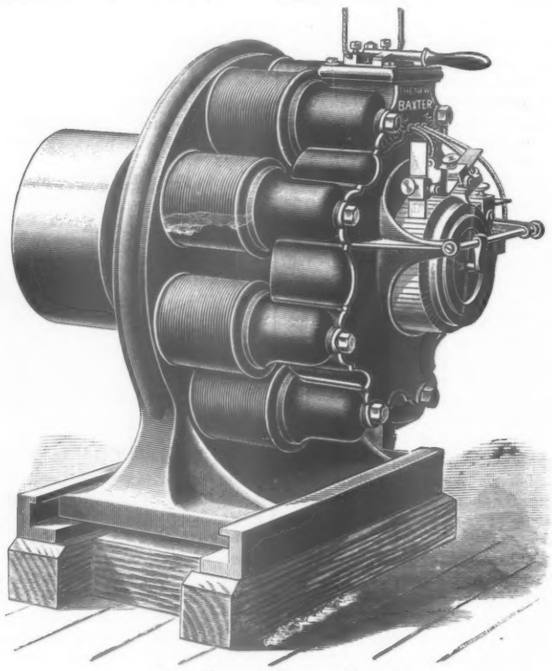
* * Portland is to have a new electric motor line. It is to be built by the Willamette Heights Railway Company, which company has filed articles of incorporation. The capital stock is $100,000

* * The city of New Orleans has taken a step which shows her people to be fully imbued with enterprise, and determined to favor their citizens with the latest improvements in the field of science. The latest manifestations of this spirit is shown in the partial consolidation of all the street railway lines in the city and suburbs, and the election of the presidents of the different lines as a board of trustees to build and run a system of electric railways over the entire territory. Contracts have already been entered into, and the work on the central power station is now in progress. The cars are to be propelled by storage batteries. The work of construction is under the charge of Mr. Daniel Fox, formerly of this city, who has been connected with electric enterprises in New York and vicinity for several years.

* * The Electric Traction and Manufacturing Company of New Orleans is preparing to manufacture electrical apparatus on a large scale under the Gibson patents. Sixty electric cars will soon be in operation on the Cresent City line of street railway.

* * The application of the Troy and Lansingburgh Railroad Company to make the change from horse to electric motor power on that part of its road in the village of Waterford has been granted by the State board of railroad commissioners

* * Among the cities which are now adopting electricity as a motive power on their roads is Buffalo, N. Y. The Buffalo Street Railway Company, about two months ago, made a contract with the Sprague Electric Railway and Motor Company, of New York, for the equipment of four electric cars. This equipment was intended only to try the electric system, and if the trial should be successful, it was contemplated that an equipment of a very large number of cars would be operated upon this road. The cars have been in operation about four weeks and carry large numbers of passengers. Upon a recent Sunday, the four cars and four trial cars carried 24,600 passengers without the loss of a single trip. This is a good record, considering the small number of cars operated and the grades upon the line.



New Type of Baxter Motor.

* * An Indianapolis contemporary says: "Fight it who may, the day of the dominion of electricity is here. 'As well try to dam up the current of the Nile with bulrushes' as to interpose flickering gas and weary mules as barriers against the oncoming tide of electrical supremacy. In every city the electric current is being utilized for illumination and for driving machinery. Indianapolis is not to be behind in this, and it requires no hoary-headed prophet to foretell the day when her streets will all be light at night and her cars will run swiftly, noiselessly and without dust, because of the reign of electricity."

* * An effort is making to consolidate the two lines of street cars in Des Moines, Iowa, one operated by horses and one by electric power. The horse car line has been in operation 21 years, and its charter has nine years yet to run. The electric plant was put in operation last December, and its success has been such that the old line is practically valueless, and is running behind rapidly. Two years ago it was sold to a syndicate composed chiefly of the nephews of Senator Sherman, of Ohio, for $225,000. The electric plant is valued at $350,000, although a year ago it could have been bought for $60,000. The gentlemen interested in the deal have an option on both lines, which expires September 12th, at an aggregate price of $600,000.

* * The right to erect street railway poles for overhead wires has been granted the Albany, N. Y., Street Railway Company.

* * The Stillwater, Minn., electric road is now in full operation using the Sprague system, with entire success, so Supt. Ober says.

* * Up to this time, many of the electrical manufacturers have confined themselves to small motors, and, although all have acknowledged that the transmission of power on a large scale is feasible and practicable, yet so far, it has been found commercially more desirable to keep down the size of motors to something like 25 horse power or less. We understand the Sprague Electric Railway and Motor Company have received orders recently for a larger motor which has had the result of calling forth their present new 75 horse power motor. This machine is not dissimilar in appearance to the ordinary Sprague electric motor of smaller sizes; the first one of these motors manufactured was for the Kearney Paper Company, of Kearney, Neb., where about 120 horse power of electric motors, built by the Sprague Company, will be used for operating the entire mill. The current for driving these motors is generated by water several miles away. The efficiency of this machine is high, while at the same time the speed is kept quite low, the motor making only about 500 revolutions a minute while operating under full load.

The New Baxter Motor.

From an inspection of the cut we present herewith, it will at once be seen that there is no resemblance whatever between the new and the old Baxter motor. In the new machine a radical departure has been made from the principles of construction ordinarily adopted in electric machines. This change has been brought about by a series of theoretical investigation, which have pointed out the fact that a very great reduction can be made in the weight as well as in the velocity of a machine by following certain principles in its construction.

As will be noticed, the field is composed of eight coils, which are wound so as to give to the magnetic lines of force a particular direction. By a certain method of winding the armature and of commutation, the electro-motive forces set up in the armature conductors by the inductive action of the field coils are added to each other in such a manner as to develop the required difference of potential at a very low velocity. As a consequence of this disposition of the field and the method of commutation, all the brushes are located on one side of the commutator, being placed on top as shown in the cut.

The governor is located within the commutator, and its motion is transmitted to one of the brushes by a cross shaft and levers, as shown. Owing to the arrangement of the circuits in the machine and the method of commutation, the movement of the brush by the action of the governor affects the counter electro-motive force of the armature, and in this way regulates the velocity of the machine. A very slight movement of the brush is sufficient to render the counter electro-motive force to zero, therefore a very much closer regulation can be obtained than by the method of regulation used in the old Baxter motor.

The governor is so proportioned as to give to the brush the motion necessary to reduce the counter electro-motive force from the maximum to zero by a variation in speed of two per cent. If the speed varies more than this the counter electro-motive force is not only reduced to zero, but is reversed and therefore tends to hold back the armature. This feature makes racing impossible, because as soon as the speed runs two per cent. above the the normal velocity the armature will begin to resist rotation, and if the increase in speed is as much as four per cent. the force with which the armature will resist rotation will be as great as the total force of the motor when giving the maximum output.

The property of this motor in virtue of which it can reverse the ring of the armature electro-motive force by a slight acceleration in speed is of great importance in motors used to run spur-geared elevator machines. Motors regulated by cutting out the field cannot be used for this purpose unless specially wound, so as to resist rotation when the elevator platform descends. Mr. Baxter patented a method of winding to adapt the old motor to this class of work, but the regular standard machine of the old Baxter type, although wound in this way to a certain extent, will not set up a rotative moment in opposition to the direction of rotation sufficiently great to check the speed of descent, as the negative torque is intended only to produce more perfect regulation and to prevent racing when the load is suddenly thrown off and therefore is only enough for this purpose.

To understand the necessity of making a motor hold back with a force nearly as great as its maximum capacity in order that it may be adapted to operate spur-geared elevator machines, it must be borne in mind that when an elevator of this type descends with a full load it will fall about as fast as a body will drop through the air, unless its motion is resisted in some way. To keep the velocity of descent down to about the same ratio as the ascending velocity, it is necessary to interpose some kind of resistance. This resistance must be supplied by the motor itself and must be about two-thirds as much as would be required to raise the same load, as not more than one-third will be balanced by the friction of the elevator mechanism. The

new Baxter motor as shown above will furnish this mechanical resistance with a rise in velocity of less than four per cent. above the normal speed.

It is evident that it is a very great advantage to have a motor of such a character that it is adapted perfectly to all the various conditions of running to which it may be subjected, that it may be used to run any kind of machinery without modifications of any kind.

The governor in this motor is so constructed that the space it takes up when compared to the force it develops, is very small. It is on this account that it can be made small enough to be located within the commutator.

This arrangement not only makes the machine more compact, but removes the danger that must necessarily exist of accidentally injuring the governor or its connection when they are placed in an exposed position. All the moving parts of the governing mechanism, with the exception of the weights, are very tight, and their movement very short. It is on this account that such close regulation is possible. The force necessary to move the regulating brush and the connections between it and the governor is less than five per cent. of the total force of the governor; therefore, any variation that could possibly be brought about in the frictional resistance of the moving parts could not have any noticeable effect in regulation, as 95 per cent. of the governing force is resisted by the tension of springs which is for all practicable purpose constant. Hence the resistance to the governor is at all times practically constant and therefore the action at a given speed always the same.

The extreme simplicity of the method of regulation, as well as the mechanical perfection of the governing mechanism, are not the only points of novelty in this new motor. The resistance in velocity at once removes most of the difficulties that users of electric machines have to contend with. Heating of the journals is almost entirely due to high speed, and sparking at the commutator, though not wholly due to this cause, can in most cases be entirely subdued by a reduced velocity. The running parts of a machine will last longer the slower they move. If the velocity is one-third, their life should be three times as long. The repairs ought to be in the same proportion. There are now nearly 2,000 Baxter motors of the old type in use, and the cost for repairs on the whole lot does not average two per cent. per year. As the new motor runs at about one-third the speed the repairs should be less than one per cent. per year.

The new motor is lighter and smaller than the old one, notwithstanding that it runs at such a low velocity. A two horse-power motor of the new type will weigh about 190 pounds, will run at 800 revolutions per minute, and is 16 inches high, 14 inches wide and 17 inches long. The 10 horse-power motor weighs less than 800 pounds, runs at 600 revolutions, is 22 inches wide, 26 inches high and 25 inches long.

The velocity of the various sizes of these motors will range between 500 and 900 revolutions per minute, and the mechanical output from one horse-power for every 120 pounds of machine in the smallest size to one horse-power for over 40 pounds of machine in the largest ones. The efficiency is also higher, a commercial efficiency of 90 per cent. being obtained in motors as small as two horse-power, and in the larger sizes a result even better than this attained.

—— The new plant of the Morristown, N. J., Electric Light Company will be in working order by October 1st. The machinery, including boilers, is now in the building, and will be set up this week. The stack, 60 feet in height, will be completed in a few days, and the building is completed, with the exception of a few minor details. A contract has been made with the town for 110 twenty-five candle-power lamps, to burn every night and all night, except when there is an unclouded moon. The entire cost of the plant will be about $25,000. About 500 lamps have been subscribed for, in addition to the street lighting.

Quick Work at an Electric Light Station.

The cylinder head of the new Corliss engine at the United Electric Light Company's plant in Springfield, Mass., blew out about 10.05 o'clock Friday night and went through a window knocking out some of the brick work. All the electric lights went out, but were put in working condition in seven minutes. It will require a week's time to repair the engine. The other two engines were started up and will be used during the disablement of the other engine. The company is entitled to great credit for the remarkably quick work in getting the lights in operation.

—— A Vermont electric company have just put into the Amoskeag mill at Manchester, N. H., an incandescent plant of 300 lights. They have also secured the contract for furnishing a woolen mill in Lewiston, Me., with a plant of 600 lights.

—— The Edison Electric Light Company last week presented to the Hackensack (N. J.) commission a satisfactory bond for the fulfilment of their contract to light the streets of that town with electricity, and it is understood that the work of putting in the plant and erecting the poles will begin at once. The gas company consents to continue lighting the street lamps until the new lights are ready.

—— The Westinghouse Electric Company has obtained six contracts for the machinery of as many incandescent light plants. The total number of lights amounts to 3,750 lamps, and they will be divided among the following places: McMinnville, Ore., 500; Keokuk, Ia., 750; Vandalia, Ill., 750; Albany, Ore., 500; Victoria, Tex., 500, and Lincoln, Ill., 750. All of these plants will be fitted up with the alternating current system.

—— Mr. L. H. Rogers, the Boston agent of the Brush Electric Light Company of Cleveland, Ohio., has been in Dexter, Me., and closed a contract with the Dexter Electric Light Company to furnish a long distance dynamo of the Brush pattern which will be put in at Libby's mills. This involves the purchase of the water power there by the company. The necessary arrangements to put it in speedy operation will be made. A Leffel wheel will be put in for power.

—— The Greenville Water and Electric Light Company, of Greenville, Tex., a corporation composed of S. W. Fordyce, R. C. Kerens, Thomas Howard, John W. Harrison and F. B. Nichols, of St. Louis, and J. M. Cook, E. B. Perkins, Thomas King and J. D. Lasater, of Greenville, elected the following officers and directors on the 5th inst.: J. M. Cook, president; E. B. Perkins, vice-president; F. B. Nichols, secretary and treasurer; Thos. King and J. D. Lasater, directors.

—— Gloversville, N. Y., has made a contract with the new electric light company for 70 street lights, of 1,200 candle power, at $60 per light a year, the contract to commence November 30, 1889. This company is negotiating for power at Peck's pond. The Johnstown Company, its rival, through its superintendent, purchased land bordering on the pond, with a view of circumventing the new company, and now claim the dam must be lowered, thus decreasing the water power and forcing the new company to use steam power.

—— In the act making appropriations for the expenses of the government of the District of Columbia for the fiscal year ending June 30, 1890, there is a proviso directing the commissioners to investigate and report to Congress at its first session what deduction may be made for gas and electric lighting, both for annual and for five year contracts. The commissioners, in letters to the gas and electric light companies in the city, request a full expression of their views as to whether the present price of gas lighting and electric lighting in the District can be properly reduced either for one or five-year contracts.

—— The Brush electric light station at Rochester, N. Y., is being enlarged.

—— The Manchester (N. H.) Electric Light Company is putting in a new 150 horse-power boiler and a 500 horse-power compound condenser engine. The value of the plant is to be increased to the extent of nearly $20,000.

—— The engine houses for the dynamo plants for the London district are already built at Deptford and cover 40,000 square feet. Preparations are going forward at Glasgow, Edinburgh, Leicester, Reading, and other towns, for extensive electric lighting.

—— The board of directors of the South Omaha, Neb., Electric Light Works met recently and decided to add to their plant all that is necessary to meet the demands made for more light. The plant is now in good working order and giving general satisfaction.

—— The Holley Electric Company of Orleans, N. Y., has its plant nearly completed. The system used is made by the Western Electric Company of Chicago. The commercial service has been in successful operation since August 1st and is giving complete satisfaction.

—— The Pond Engineering Company sold to the Fort Scott Electric Light and Power Company, of Fort Scott, Kan., a 125 horse power Armington & Sims engine, a few days ago, making the third engine of this kind that it has recently sold to the same company.

——About 10 per cent. of all the new books received at the Boston Public Library during the month of August are on electrical subjects. Nearly one-half of this number are in the French language, among them being an edition of Gisbert Kapp's treatise on the "Transmission of Energy."

—— The People's Electric Motor and Light Company's plant at St. Joseph, Mo., is nearly complete. Four large Babcock and Wilcox boilers are already in but the engines are not yet in place. An Edison plant will be used for power and a Westinghouse lighting plant will be installed.

—— The Duluth (Minn.) Electric Company is making preparations for largely increasing the size of its plant. The building of the company will be raised two stories, another engine and boiler will be put in, as well as new appliances. James McLane, of New York, has been engaged as superintendent.

—— The electric light company, of Salem, Mass., is busily engaged in putting in incandescent lights all over the city. A new rule just adopted has tendered to make the service more popular. The company now charges nothing for the labor of setting up the lights, but exacts payment for new lamps furnished after the first one is broken.

—— James C. Bayles has made application to the East Orange (N. J.) township committee for a franchise to lay subways and electric conduits in the town ship. He proposes to organize a company of East Orange residents to supply the township with electric light and power. The subways are to be laid under the outer edge of the sidewalk.

—— The Rockville, Conn., Gas Light Company has placed a contract with the Thomsom-Houston Electric Company for a 110 arc light plant, 74 of which will be for public lighting and the remainder for commercial purposes. The Wright Electrical Engineering Company will do all the line construction work which will include about 500 poles and 21 miles of wire.

—— L. J. Wing, of the Thomson-Houston Electric Light Company, has closed a contract with the Vermont Marble Co., to furnish the works of the company at Proctor, Vt., with a complete electric light plant. The contract calls for 53 arc lights of 2,000 candle-power each, 150 incandescent lights of 32 candle-power each, two dynamos for the arc lights, and one for the incandescents.

ELECTRIC LIGHT NEWS

—— Savanah, Ga., is increasing its electric lighting plants.

—— The Andover, Mass., electric lighting system has met with pronounced success.

—— An electric light plant is being put in at the new Post Office building in Minneapolis.

—— The Brush plant at Bangor has proved entirely satisfactory and has been accepted by the city.

—— The Allegheny, Pa., councils have awarded the city lighting contract to the Westinghouse Company.

—— The Mather Company is enlarging the electric light plant for the American mills at Rockville, Conn.

—— The Allegheny, Pa., council has finally decided on the Westinghouse system of lighting with the Star Iron Towers.

—— The Schuyler plant at Alexandria, Va., is in running order and giving great satisfaction to the public and the company.

—— The wires of the Thomson-Houston Company in Indianapolis are being put underground in specially constructed conduits.

—— The Jamestown, N. Y., City Council has finally decided to contract for lighting with the Jamestown Light and Power Company.

—— The Edison Company in Philadelphia has been fined $50 for violating a city ordinance relating to the laying of underground conduits.

—— River Falls, Wis., is to have electric lights. The National Electric Manufacturing Company, of Eau Claire, will put in the plant.

—— After a somewhat heated controversy the East Albany, N. Y., Electric Company has been awarded the contract for lighting Greenbush.

—— Dr. W. T. English in a recent essay takes the ground that electric lighting and electric street cars in cities improve the general health.

—— The Denver, Col., Consolidated Electric Light Company has offered to extend its wires and system to the jail and hospital buildings.

—— The Warren (R. I.) Electric Light Company has organized by the election of John Waterman, president, and B. M. Bosworth secretary and treasurer.

—— The Seattle (W. T.) Gas and Electric Light Company has received by rail its new 150 horse-power engine and boiler, and will soon add to its plant 100 new arc lights.

—— Melvin R. Ludwig, formerly of the Edison Electric Light Company, at Lawrence, Mass., has been tendered the position of superintendent of the electric lighting system of Paterson, N. J.

—— The city plant at St. Joseph, Mo., is slowly nearing completion. Power is furnished by two Williams high speed engines 150 horse-power each. Eight large Excelsior dynamos will furnish current for 300 arc lights.

—— The Milwaukee *Sentinel* recently announced that the city of Oskosh would soon put in a municipal lighting plant, and electric light agents have made Oskosh their Mecca since. The decision as to system has not yet been made.

—— The Westboro, Mass., Electric Light and Power Company is to double the capacity of its plant at once. An incandescent dynamo with capacity for 750 lights, a 120-horse-power boiler and a 100 horse-power engine will be added.

KINDRED INTERESTS

The Westinghouse Machine Co. has given orders to the men that they will have to work on double turn in the future. This has become necessary on account of the enormous increase in the demand for Westinghouse engines. The monthly sale amounts at present to 80 engines, but orders have lately come in very rapidly, not only asking for a larger number of engines but also for greater horse-power. One-third of the production of the company is shipped to foreign countries.

The Pond Engineering Co. will furnish the Hutchinson, Kan., Water, Light and Telephone Co. with a 100 horse-power Armington & Sims engine, being the fourth engine of that make which the company has in their station. It will have a special new feature; a clutch will be placed on the driving wheel so arranged that, with the engine running steadily, the driving wheel can be run or not as desired. They will also furnish the Edison Illuminating Co., of Topeka, Kan., with Iresoc leather link belting, and the Metropolitan Railway Co., of Kansas City, with a Tracy patent oil filter. The Pond Engineering Co. has been awarded the contract for the pumping engines, boilers, etc., for the Belleville, Kan., Water Works.

The Eclipse Wind Engine Co., Beloit, Wis., are very busy, running night and day on orders from Puget Sound, Mexico, Massachusetts, Kansas and elsewhere. The Wm. Deering Co. (agricultural machinery works), Chicago, order a full outfit of friction pulleys, shafting, etc. The Holyoke Machine Company order a large number of pulleys and couplings to equip electric plants in Worcester and Lee, Mass. Among the pulleys now on the floor is one with a six-armed clutch on each side—something new—and one ten feet in diameter, with a 42-inch face, weighing over 7,000 lbs. The demand for machinery is so great that the company is now for the fourth time within two years enlarging its works and adding new machinery. The growing popularity of rope transmission of power brings many orders for friction split rope sheaves.

Cincinnati Electric Railway.

In the accompanying engraving we give a view of one of the Sprague electric cars on the Cincinnati Inclined Plane Street Railway. This railway runs from the center of Cincinnati to the foot of an incline where the cars are hoisted on elevators to the top of the bluff which surrounds Cincinnati, and there run by means of electricity through the suburbs to the Zoological Gardens. This is the first electric line installed in Cincinnati, and shows how successful the street railway problem in that city has been solved, and how a substitute for cable roads has been gained.

The view given shows the car rounding the corner of Fifth and Walnut streets; the post office being on the right and Fountain square on the left.

The style of poles used is shown by a single iron pole on the corner, and is a sample of the kind of poles used throughout the line. These iron poles are only four inches at the top, and are very much lighter and neater looking than the ordinary electric railway pole. In the residential district the streets are bordered with trees, so that the poles are completely covered and cannot be seen.

On Fifth street, just to the right of the poles shown in the engraving, there is a stretch of 550 feet where only three span wires are used, although the street is 200 feet wide. This could only be possible with the light silicon bronze trolley wire of the Sprague system by means of which only a small portion of current is required to be carried from the center of the street, while the greater portion is carried on main conducting wires on the side of the street. The equipment of this road includes 20 cars.

CINCINNATI ELECTRIC RAILWAY.

The Entire Globe to be Lighted.

TO THE EDITOR OF ELECTRICAL REVIEW:

At the present day the production of artificial light, that is, light other than that produced by the planetary system, must be confined to the employment of gas, electricity or oil, the consumption of which forms a large item of expense in the existence of mankind.

There is now undergoing the process of perfection an instrument which is called the far-sight machine, by the use of which we may at no distant day be enabled to see the faces as well as to hear the voices of our distant social or business friends.

This will be accomplished by the perfection of an idea that light waves may be carried and reproduced as well as those of sound. But, it will be said, what may this have to do with lessening the cost of light, even should the transmission of light be affected? Where would the light be obtained to transmit without necessitating the generating by artificial means?

This question can be answered by the asking of another, equally as natural, *Is the earth dark everywhere at the same time?* Is there not daylight in China when there is darkness in the United States. Do you not suppose that there would be enough light in the sun to illuminate the entire earth at one moment, could it only be spread or conducted by some means to those parts of the globe that it is needed?

Surely not in this century, and perhaps not in the next, but some time may not the great sun illumine both the day and the night of every country? It certainly seems within the bounds of possibility. H.W.D.

Bridgeport, Conn., August 31, 1889.

Test of an Automatic System.

The trial of the new automatic block railroad signal took place on the Pittsburgh and Western Railroad, last week.

The first trial made was that of a train moving on a single track, and protecting itself in front and rear by means of the danger signals. As the brush, connected with batteries, touched the conductor of the signal apparatus, danger signs were instantly shown in the front and in the rear of the train. One of the advantages claimed for this automatic signal is that if anything occurs to the batteries, throwing them out of order, the signals instantly show danger, and the engineer is at once warned either of the approach of a train in a certain block or of great reason for caution in his movements. Experiments were also made illustrating the manner in which a train on a single track could protect itself in front and in rear, and how a train on a double track could protect itself in the rear.

Another test, however, was one where the approach of two trains on the same track was shown, and their simultaneous protection in both front and rear. As the two trains rapidly neared each other, the danger signal all at once flashed up in front of them, and they were quickly brought to a standstill, thus preventing a collision. Then as one or the other train would move away the signal would give notice to the other to come on, and they would thus be worked in the neighborhood of each other with perfect freedom.

The inventors are Messrs. T. D. Williams and J. S. Lacock, of the Western Union Telegraph Company.

ELECTRICAL PATENTS

INDEX OF INVENTIONS FOR WHICH LETTERS PATENTS OF THE UNITED STATES WERE GRANTED IN THE WEEK ENDING SEPT. 17, 1889.

411,016 Manufacture of carbon filaments; Thos. A. Edison, Menlo Park, N.J., assignor to the Edison Electric Light Company, N.Y.

411,017 Carbonizing-flask; Thos. A. Edison, Menlo Park, N. J.

411,018 Manufacture of incandescent electric lamps; Thos. A. Edison, Llewellyn Park, N. J.

411,019 Manufacture of incandescent electric lamps; Thos. A. Edison, Llewellyn Park, N. J.

411,020 Manufacture of carbon filaments; Thos. A. Edison, Llewellyn Park, N. J.

411,030 Combined electric motor and blower; Chas. J. Hirlimann, Fort Lee, N. J.

411,042 Electric meter; Harold W. Kolle, London, County of Surrey, England.

411,058 Mechanical telephone; Cass M. Radford, Concord, N. H., assignor to himself, Frank L. Blood, Groton, and Freeman Emmons, Wakefield, Mass.

411,088 Arc lamp; Frederick R. Boardman, London, County of Surrey, England, assignor of one-half to Bemat Carl Wilhelm Petersen and Mads Peter Hardt, same place.

411,093 Instrument for connecting line-wires; William H. Coughlin, Worcester, Mass., assignor of one-half to Herbert H. Fairbanks, same place.

411,107 Lamp shade holder; Chas. G. Perkins, Hartford, Conn.

411,124 Receptacle for secondary batteries; Fred. W. Huestis, Newton, Mass.

411,133 Electric polarized annunciator; Chas. E. Scribner, Chicago, Ills., assignor to the Western Electric Company, same place.

411,138 Electric clock system; Chas. H. Carter, Brooklyn, N. Y.

411,137 Metallic circuit; Henry F. Campbell, Malden, assignor to Albert C. Pond, trustee, Boston, Mass.

411,150 Electro-motor; Mary A. Kissell, Chicago, Ills., executrix of Abraham S. Kissell, deceased.

411,198 Telegraph key; Alfred E. Johnson, Carson City, Nev., assignor of one-half to Moses M. Cohn, same place.

411,204 Pole for supporting electric conductors; Sidney H. Short, Columbus, Ohio.

411,330 Electrical high and low water alarm; Daniel H. Steeper, Norristown, Pa

411,287 Electric arc lamp; Frank E. Kinsman, New York, N. Y.

411,301 System of electric generation and distribution for railway cars; Elias E. Ries, Baltimore, Md., assignor to Ries & Henderson, same place.

411,311 Thermostatic fuel controller; Edmund R. Ware, Worcester, Mass., assignor to the Ware Automatic Heat Generator and Regulator Co.

411,313 Overhead frog for electric railways; Merle J Wightman, Lynn, Mass.

411,314 Overhead frog for electric railways; Merle J. Wightman, Lynn, Mass.

411,370 Connector for secondary batteries; Sidney H. Barrett, Springfield, Mass., assignor to the Railway Electric Car Lighting and Signal Company of New York.

411,380 Cut-out; Friedrich G. A. Heller, Berlin, Germany, assignor to Siemens & Halske, same place.

411,396 Holder for electric light shades; Harry H. Sawyer, Ridley Park, assignor of one-half to the Thackara Manufacturing Company, Phila., Pa.

411,400 Galvanic battery; William C. Thompson, Minneapolis, Minn.

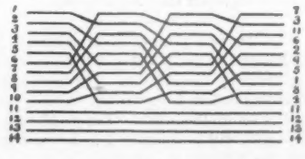
411,407 Municipal signal apparatus; John C. Wilson, Boston, Mass., assignor to the Municipal Signal Company, Portsmouth, N. H.

$1,000 REWARD.

I WILL PAY $500 for information sufficient to effect the discovery and conviction of the thief who broke open my desk at my office and stole therefrom papers and documents, alleged copies of some of which were published in the New York *Sun* of August 25, 1889. I will also pay $500 additional for the return of the stolen property.

HAROLD P. BROWN,
45 & 47 WALL STREET, NEW YORK.

TELEPHONE COMPANIES, transpose your Metallic Circuit or Pair Cables. Use all Conductors for Single or Metallic Circuits as required. Reduce Outlay for Cables nearly 50 per cent. Save interest, depreciation and rentals, and secure latest improved Cables at lower prices when needed for actual service. Transposition Plates, just patented.



For terms and details, address,

H. A. PITCHER,
General Agent,
Room 58, Garfield Building
BROOKLYN, N. Y.

SITUATION WANTED. — To run central station; can run engines; two years' experience. T.-H. system preferred. Best of references.

Address, ELECTRICIAN,
Box 337. Southbridge, Mass.

C. M. BLANCHARD.
ELECTRICAL CONTRACTOR
& ENGINEER.
1429 Walnut Street,
PHILADELPHIA.

Estimates given and contracts made for Incandescent and Arc Lighting, Electrical Street Railways, &c. Steam and Electrical Plants of any system furnished complete.

Standard Electrical Test Instruments,

AMMETERS AND VOLTMETERS
AYRTON & PERRY NEW SPRING.
Carpentier, Hartmann & Co., Galvanometers, Bridges and Rheostats
James W. Queen & Co.
924 Chestnut St., PHILA.

WALTHAM

WATCHES

are the best for electricians, railroad men, engineers and others whose vocation requires a watch that is both absolutely non-magnetic and an accurate timekeeper.

Manufactured and Warranted by the
AMERICAN WALTHAM WATCH CO.
WALTHAM, MASS.

ELECTRICAL MEASUREMENT
Instruments and Batteries of the Very Highest Grade.
Precision and Constancy, Quality and Finish the Best in the World.
Catalogue of Standard Test Instruments furnished upon application.
THE E. S. GREELEY & CO.,
5 AND 7 DEY ST., NEW YORK.

W. R. OSTRANDER & CO.
21, 23 & 25 ANN ST., NEW YORK.
Manufacturers of
SPEAKING TUBES, WHISTLE ANNUNCIATORS, Electric & Mechanical Bell.
FACTORY,
De Kalb Avenue,
BROOKLYN.
Send for Illustrated Catalogue.

CONDENSERS WM. MARSHALL, MANUFACTURER. Standards a Specialty
Rooms 2 and 4, University Building, New York.

ELECTRICAL CONTRACT WORK.
Detailed Estimates Mad and Contracts Taken for
EQUIPMENT OF COMPLETE STEAM AND ELECTRICAL PLANTS
of any System of Arc and Incandescent Lighting.
CENTRAL STATIONS,
And ELECTRIC STREET RAILWAYS, operated overhead underground, or by storage batteries.
Address—
EUGENE T. LYNCH, Jr., Consulting Engineer,
120 BROADWAY, NEW YORK.

DUST PROOF BELLS.

HAZAZER & STANLEY,
ELECTRICAL HOUSE FURNISHINGS,
32 & 34 FRANKFORT STREET,
NEW YORK.

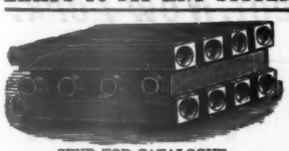
SERIES LAMPS. LONG LIFE. LOW PRICE BATTERY LAMPS. HIGH EFFICIENCY.

PHŒNIX

INCANDESCENT LAMP CO.

13 to 17 N. JEFFERSON STREET, CHICAGO, ILL.

LAMPS TO FIT ANY SYSTEM, ANY VOLTAGE OR CANDLE POWER.



SEND FOR CATALOGUE.

THE WYCKOFF PIPE CO.,
MANUFACTURERS OF
WOODEN PIPES FOR
UNDERGROUND ELECTRICAL WIRES.
We have large works for creosoting Lumber, R. R. Ties, Telegraph Poles, &c., &c.
WILLIAMSPORT, PENN.

THE FIRST REAL IMPROVEMENT IN POROUS CUP BATTERIES.
A GREAT STEP IN ADVANCE OVER THE OLD FORMS.

"AXO" BATTERY COMPLETE with Jar adapted for Sealing.

TRADE AXO MARK

E. M. F., 1.60 VOLTS.

"AXO" POROUS CUP.

The "AXO" is rapidly driving out all other Porous Cup Batteries.
SEND FOR DESCRIPTIVE CIRCULAR,
The Leclanche Battery Co., 149 W. 18th St., N. Y.

EUGENE F. PHILLIPS, PRESIDENT. W. H. SAWYER, SEC. & ELECTRICIAN.

AMERICAN ELECTRICAL WORKS,

Manufacturers of Patent Finished
ELECTRIC LIGHT WIRE,
MAGNET WIRE, OFFICE & ANNUNCIATOR WIRE,
RUBBER COVERED WIRE, LEAD ENCASED WIRE,
TELEPHONE & INCANDESCENT CORDS.
FARADAY CABLES.
Office and Factory, 67 STEWART ST., PROVIDENCE, R. I.
New York Office, 18 Cortlandt St., P. C. Ackerman, Agent.

EUGENE F. PHILLIPS, PRESIDENT. JAMES COOPER, SEC. & TREASURER.

EUGENE F. PHILLIPS ELECTRICAL WORKS, LTD.
Manufacturers of
ELECTRIC LIGHT WIRE,
MAGNET WIRE, OFFICE & ANNUNCIATOR WIRE,
RUBBER COVERED WIRE, LEAD ENCASED WIRE,
TELEPHONE & INCANDESCENT CORDS.

FARADAY CABLES.
Office, 204 James St., Montreal, Canada. | Factory, St. Gabriel Locks.

Detroit Electrical Works
MANUFACTURERS OF
ELECTRIC SUPPLIES,
INCLUDING
Medical Batteries, Skeleton and Box Bells, Burglar Alarms, House Annunciators, Fire Alarm Boxes, Pins and Brackets.
Insulated Magnet, Telephone and Electric Light Wire.
GENERAL OFFICES and FACTORY:
DETROIT, MICH.

D. W. Baker. Cyrus O. Baker, Jr.
BAKER & CO.,
Importers, Melters and Refiners of
PLATINUM,
408, 410, 412 and 414 N. J. R.R. Ave., NEWARK, N. J.
Platinum in sheet and wire, all sizes, and any degree of hardness. Scrap and native platinum purchased

PAILLARD NON-MAGNETIC WATCHES.

AVOID ALL IMITATIONS.

SEE THAT "Paillard's Patent" "Balance —AND— Spring" Is engraved on each movement

18 size full plate movement.

These Movements are of American Manufacture, and are the only American Movements made containing the Celebrated Paillard Inventions.

The Best American Non-Magnetic Watch.

Warerooms, 224-232 Canal St., 118-126 Walker St.,
NEW YORK.
Manufactory, Flushing & Carlton Avenues, Brooklyn.

OXLEY, GIDDINGS & ENOS,
DESIGNERS AND MAKERS OF
Electroliers and Combination Fixtures

UNSURPASSED FACILITIES
For producing fixtures of the most approved designs for any system of
INCANDESCENT LIGHTING.
Special designs furnished upon application. Suggestions from architects and decorators faithfully executed.

THE KNAPP ELECTRICAL WORKS,

MANUFACTURERS OF

ELECTRICAL APPARATUS AND SUPPLIES,

ANNUNCIATORS, BURGLAR ALARMS, BELLS, BATTERIES, &c.
Electric Light, Telegraph, Telephone and Fire Alarm Supplies.

AGENTS FOR

NEW YORK INSULATED WIRE CO., Grimshaw White Core and Braided Wires, Tapes, &c.
J. H. BUNNELL & CO., Telegraph Instruments, Line Equipments, Etc.

54 & 56 FRANKLIN STREET, CHICAGO, ILL.

Plating Machines that require a speed from 1800 to 3600 revolutions per minute are Useless Toys.

$100.00

THE

"LITTLE WONDER"

DYNAMO-ELECTRIC MACHINE.

Over 1000 in Successful Operation. Has the largest sale of any Electro-Plating Machine.

SEND FOR CATALOGUE OF 1889.

Manufactory and Offices,
Newark, N.J.

New York Office, 32 Liberty Street.

PRESSURE-RECORDING GAUGES.

JARVIS B. EDSON, 87 LIBERTY STREET, N. Y.

Columbia College SCHOOL OF MINES.

A COURSE IN
ELECTRICAL ENGINEERING

Has been established, oper to graduates of the School of Mines and of other institutions of like grade and standing. The full course will occupy two years. Ther is a partial course that can be completed in one year.

For circulars apply to Registrar School of Mines, 49th street and Madison ave., New York City.

HENRY DRISLER, LL. D.,
Acting President.

Root Electric Gas Lighter.

By this system of Electric Gas Lighting, house and fixture wiring are dispensed with. Each light is complete and independent. Full information will be given on application.

Liberal terms to agents,

Root Electric Gas Lighting Co.,
Rooms 612, 613 and 614, 225 Dearborn St., Chicago.

SPRAGUE
Electric Railway and Motor Company

ELECTRIC, MINING AND RAILWAY APPARATUS.

Motors and Dynamos of Special Types and Designs for the operating of Street Cars, and all kinds of Mining Machinery, such as

CRUSHERS,
CONCENTRATORS,
HOISTS, TRAMS,
PUMPS, ETC.

Full Information on Application.

ADDRESS

16 & 18 Broad Street, New York.

POND ENGINEERING CO.,

ENGINEERS AND CONTRACTORS.

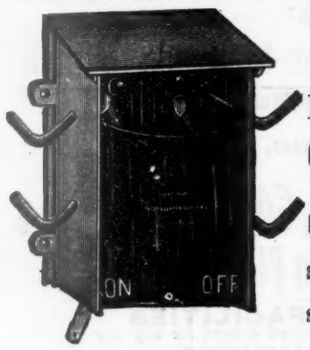
Complete Steam Plants for Electric Light and Power.

Engines, Boilers, Furnaces, Grates, Heaters, Pumps, Injectors, Pipe Work, Belting, etc., designed with special reference to the HIGHEST EFFICIENCY.

Our Extended Experience Enables us to Guarantee Satisfaction. Send for New Illustrated Pamphlet.

ST. LOUIS, CHICAGO, KANSAS CITY AND OMAHA.

THE E. S. GREELEY & CO.,



Nos. 5 & 7 Dey St., New York

Manufacturers and Importers of and Dealers in

Telegraph, Telephone
— AND —
Electric Light Supplies

AGENTS FOR

Cleveland Arc Light Cut Outs & Gang Switches

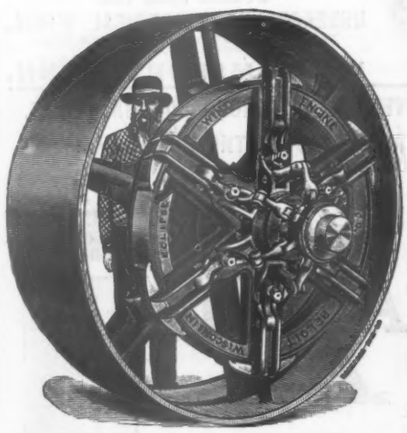
Cleats, Rosettes, Moulding, Pins, Cross-Arms, Brackets. Insulating Tapes.

Rubber, Porcelain and Glass Insulators

WIRES OF ALL KINDS.

Silk & Cotton Covered Flexible Conducting Cord of various sizes for Incandescent Lighting.

Spikes, Pole Steps, Lag Screws, Drive Screws, Turn Buckles, Etc.



FRICTION CLUTCH PULLEYS
— AND —
CUT-OFF COUPLINGS.

They are now doing the heaviest and most satisfactory work in the

Largest Electrical Light Plants.
Largest Saw Mills.
Largest Flour Mills.
Largest Elevators and
Largest Packing Houses in the Country.

Split Clutch Couplings and Pulleys a Specialty.

POWER PLANTS
Designed and Completely Equipped

ECLIPSE WIND ENGINE CO.
BELOIT, WIS.

Send for July, 1889, Catalogue, and see where and by whom they are used.

WRITE

For the Electrical Review's *New Catalogue* of all Electrical and Scientific Books.

18 PARK ROW, NEW YORK.

ARC LAMPS FOR CONSTANT POTENTIAL CIRCUITS.

We have purchased all patents and rights of the **SIMPLEX ARC LAMPS** for the United States, and also the numerous patents of F. E. Kinsman relating to the use of Arc Lamps on multiple arc circuits, either direct or alternating.

Through our many recent improvements, acquired by long experience with Arc Lamps for incandescent circuits, we are able to furnish Arc Lamps suitable for **Burning Singly or in Multiple Series** upon incandescent light or power circuits.

Superintendents and Engineers of either isolated or central station power or light plants can use any spare power to advantage by attaching our lamps, and thus lighting the streets and numerous places where arc lights are desirable, and past which their circuits run.

For prices and Information Regarding our New and Improved

MULTIPLE ARC, MULTIPLE SERIES, ALTERNATING and SEARCH LAMPS,

ADDRESS,

THE ELECTRIC CONSTRUCTION AND SUPPLY CO., 18 Cortlandt Street, New York City.

ROCK BOTTOM PRICES

ON

Cross Arms, Pins, Brackets, Insulators, Lag Screws, Pole Steps, Cross Arm Braces, Switch Boards.

Galvanized Iron Suspension Cable, Wires and Strands for Pole Guys, Annealed Iron Lamp Cord, Arc Lamp Cordage, P. & B. Electrical Compounds, Arc and Incandescent Switches, Lightning Arresters,

THE ELECTRICAL SUPPLY CO.

Eastern Office and Factory, ANSONIA, CONN.

PROMPT ATTENTION. STANDARD GOODS. ROCK BOTTOM PRICES.

Western Office and Warehouse, 171 Randolph St., Chicago.

NEW YORK BELTING & PACKING CO.

JOHN H. CHEEVER, Treasurer. 15 PARK ROW, NEW YORK.

The Oldest and Largest Manufacturers in the United States of

VULCANIZED RUBBER

In every form adapted to mechanical purposes.

MACHINE BELTING,

With Smooth Metallic Rubber Surface

This Company has Manufactured the Largest Belts made in the World for the principal elevators at Chicago, Buffalo and New York.

We make a Superior Quality of Belting for Electric Light purposes, for use on Dynamos and Swift running machinery.

SALESROOMS.

Philadelphia, 308 Chestnut St.,
Boston, 52 Summer St.,
Chicago, 151 Lake St.,
St. Louis, 907-911 North Main St.,
Denver, 1601-1611 17th St.,
Charleston, 160 Meeting St.,
Minneapolis, 28 South 2d St.,
Cincinnati, 161-165 West Pearl St.
Cleveland, 176 Superior St.,
San Francisco, 14 & 16 Main St.,
Atlanta, 16 Decatur St.,
Detroit, 16-24 Woodward Ave.,
Baltimore, 12 North Charles St.,
Buffalo, 134-138 Washington St.,
New Orleans, 54 Canal St.,
Kansas City, 1311 & 1313 West 12th St.,
Richmond, 1206 East Main St.

European Branch, Hamburg, Germany, Pickhuben 5. (Freihafengebiet).

Washburn & Moen Mfg. Co.

WORCESTER, MASS.

MAKERS OF

IRON AND STEEL

MANUFACTURERS OF

Iron and Copper Wire for Electrical Purposes.

PATENT GALVANIZED TELEGRAPH & TELEPHONE WIRE,

In Long Lengths, Galvanized by our Patent Continuous Process.

The Standard with all Telegraph and Telephone Companies.

Since the first introduction of the Electric Telegraph Service, our patent wire, expressly manufactured for electric purposes, has filled every requisition as regards strength, evenness of quality, and conductive capacity.

Send for Price Lists and descriptive pamphlets, and "Hand-book of Wire in Electric Service." Sent free on application.

New York Warehouse, 16 CLIFF STREET.

Chicago Warehouse, 107 & 109 LAKE ST.

THE TRENTON ENGINE.

AUTOMATIC CUT-OFF, BALANCE VALVE, POSITIVE EXHAUST.

ECONOMY, DURABILITY AND CLOSE REGULATION GUARANTEED.

PHŒNIX IRON CO., Trenton, N. J., B'ldrs
F. Van Winkle, 91 Liberty St. N. Y. Agent.

HYDRAULIC PRESSES.

ALL VARIETIES.

PUMPS, VALVES, GAUGES AND FITTINGS, PUNCHES, SHEARS, BUFFING MACHINERY, &c.

WATSON & STILLMAN,
210 EAST 43D STREET, NEW YORK CITY.
Special Attention to Electrical Work.

Sperry Electric Company,

Factory, 194 to 198 So. Clinton St., Chicago, Ill.

MANUFACTURERS OF THE

Improved Sperry High and Low Tension Systems of Arc Lighting,

Claiming the Highest Efficiency, Reliability and Durability. Perfect Regulation.

THE LEHIGH VALLEY

CREOSOTING CO.

WORKS, PERTH AMBOY, N. J.

Office, Foot of Washington Street, JERSEY CITY, N. J.

Creosoted Lumber, Underground Conduits, Telegraph Poles, Piling and Ties Furnished.

S. Y. L'HOMMEDIEU & CO., Eastern Agents, 65 Reade St., N. Y.

S. Y. L'HOMMEDIEU & CO., Eastern Agents, 65 Reade St., N. Y.

FARADAY CARBON CO.,

ELECTRIC LIGHT CARBONS, PITTSBURGH, PA.

W. D. SARGENT, President.
E. H. CUTLER, Treasurer and Manager.

JNO. A. BARRETT, Vice-President and Consulting Electrician.
FRANK A. PERRET, Electrician.

THE ELEKTRON MANUFACTURING COMPANY,

COR. JAY & PLYMOUTH STREETS, BROOKLYN, N. Y.

MANUFACTURERS OF

PERRET ELECTRIC MOTORS AND DYNAMOS

Automatically Regulated, Unexcelled in Simplicity and Durability.

THE ONLY MACHINES HAVING

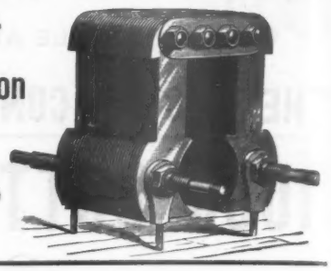
Laminated Field Magnets of Softest Charcoal Iron

BY MEANS OF WHICH

HIGHER EFFICIENCY,
CLOSER REGULATION AND
SLOWER SPEED

ARE OBTAINED THAN IS POSSIBLE OTHERWISE.

CAREFUL INVESTIGATION INVITED.



J. ELLIOTT SHAW & CO.
MFGRS & DEALERS
ELECTRICAL
53 & 55 NO. SEVENTH ST.
PHILADELPHIA
APPLIANCES

THE
India-Rubber and Gutta-Percha Insulating Co.
MANUFACTURERS OF
ALL KINDS OF INSULATED WIRES AND CABLES.

Guaranteed to give satisfactory services under ground and over head. Specially adapted for Chemical Works, Paper Mills, Dye Works, Coal Mines, etc., etc.

PRICES AND SAMPLES ON APPLICATION AT

No. 159 Front Street, New York City.

Industries.

— A —

Journal of Engineering, Electricity and Chemistry

— OF THE —

MECHANICAL AND MANUFACTURING TRADES.

PUBLISHED EVERY FRIDAY.

ANNUAL SUBSCRIPTIONS.	Thick Paper.	Thin Paper.
GREAT BRITAIN, Post Free	$6 00	$6 00
THE UNITED STATES, CANADA and COUNTRIES INCLUDED IN THE POSTAL UNION, Post Free	9 00	8 00
INDIA, CEYLON, STRAITS SETTLEMENTS, CHINA, JAPAN, &c., Post Free	10 75	9 00

SUBSCRIPTIONS PAYABLE IN ADVANCE TO

GEO. CAWLEY, 70 MARKET ST., MANCHESTER, ENG.

London Office, 22 Wellington Street, Strand; Glasgow Office, 93 Hope Street; Yokohoma Office, (Japan) 32 Main Street,

American Subscriptions to "Industries" are received by the Publisher of the ELECTRICAL REVIEW, 13 Park Row, New York.

DAFT ELECTRIC LIGHT COMPANY,

Executive Offices, 115 BROADWAY, New York.

Electric Railways and Power Stations,

STATIONARY MOTORS, STORAGE BATTERIES.

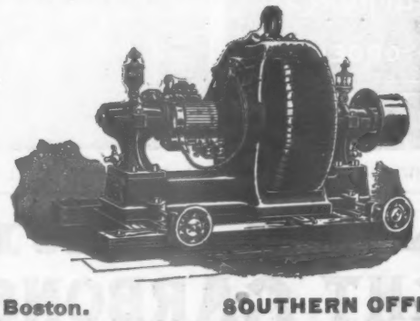
DYNAMOS, 1 to 250 H. P. MOTORS, ½ to 100 H. P.

WORKS, JERSEY CITY, N. J.

"C. & C." Electric Motor Company,

402 & 404 GREENWICH STREET, NEW YORK.

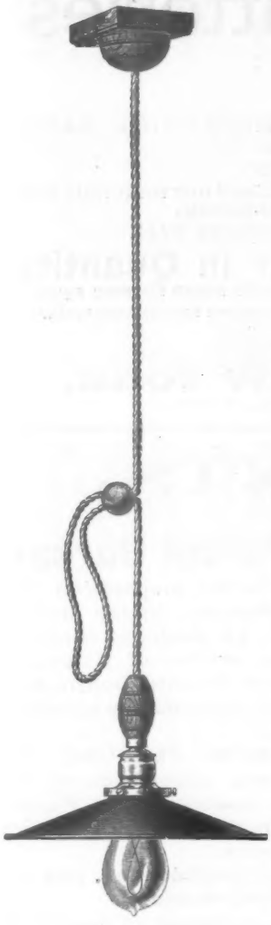
EFFICIENT
ELECTRIC
MOTORS



MANUFACTURED FOR
ARC AND INCANDESCENT
CIRCUITS.

AUTOMATICALLY REGULATED.

NEW ENGLAND OFFICE, 32 Oliver St., Boston.
WESTERN OFFICE, 139 & 141 Adams Street, Chicago.
SOUTHERN OFFICE, 25 Carondelet St., New Orleans.
PHILADELPHIA OFFICE, 301 Arch Street.



EMPIRE CITY ELECTRIC CO.,

15 DEY STREET, NEW YORK.

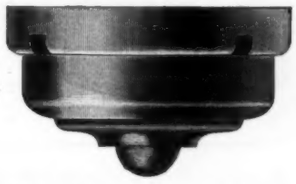
O. E. MADDEN, President. E. T. GILLILAND, Vice-President.

MANUFACTURERS AND DEALERS IN

ELECTRICAL SUPPLIES

OF EVERY DESCRIPTION FOR

Electric Light, Telegraph and Telephone Companies.



All kinds of Bare and Insulated Wires and Cables, Batteries, Bells, Annunciators, Burglar Alarms, etc., Insulators, Pins, Brackets, Cross Arms, etc.

INCANDESCENT LAMPS of best make to fit any socket.

CARBON POINTS of best Foreign and Domestic Manufacture.

ELECTRIC LIGHT "SWITCHES," "CUT-OUTS," etc., of best and latest design.

WHITEWOOD MOULDING and CLEATS at low prices.

READY FOR DELIVERY, a fine stock of well-seasoned and straight Cedar, Chestnut, and Norway Pine Poles, from 25 to 65 feet long, 6 to 9 in. tops.

NEW CATALOGUE JUST PUBLISHED.

Estimates Cheerfully Furnished. Correspondence Solicited.

In Fact, EVERYTHING in the ELECTRICAL LINE

Discount Sheet furnished to any one in the Trade on Application.

ELECTRIC BELLS of best quality, also **Batteries. E. L. CUT-OUTS AND SWITCHES on Porcelain bases.**

We have now in stock in large quantities the excellent **"STODDARD CUT-OUT,"** will be pleased to quote prices on these; and also other forms of "Cut-Outs" and Electric Light Material.

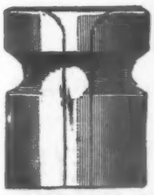
"INCANDESCENT LAMPS" of superior quality, to fit any socket and of any voltage, we can furnish at **very reasonable prices.** Please send for quotations.

The **"HARDTMUTH EMPIRE"** Carbons are **unsurpassed** in quality. We will send you a package of 50 pairs of these celebrated carbons ($\frac{7}{16}$ or $\frac{1}{2}$ in. dia.) **for trial,** at about the same rate as price per thousand.

OUR NEW "TRIPLE POINT" RUBBING CONTACT PUSH BUTTON is just the thing, and **very reasonable in price.**

Our new **"WEATHERPROOF and FIREPROOF"** Wire is meeting with much favor; price is very reasonable.

EMPIRE CITY ELECTRIC COMPANY.



Porcelain Electrical Supplies and Specialties,

MANUFACTURED BY

EMPIRE CHINA WORKS,

144 & 156 Greene St., GREENPOINT, BROOKLYN, E. D., N. Y.

Our Ware is HARD PORCELAIN, the BODY and GLAZE IDENTICAL, and GUARANTEED NON-CONDUCTIVE for all ELECTRICAL PURPOSES.

All GENUINE INGOTS & MANUFACTURES BEAR OUR REG. TRADE MARKS

Phosphor Bronze

PHOSPHOR-BRONZE

INGOTS, CASTINGS & MANUFACTURES.

THE PHOSPHOR BRONZE SMELTING CO. LIMITED

512 ARCH ST. PHILADELPHIA PA. U.S.A.

ORIGINAL MANUFACTURERS OF PHOSPHOR-BRONZE IN THE UNITED STATES AND OWNERS OF THE U.S. PATENTS.

JARVIS ENGINEERING COMPANY,

CONTRACTING ENGINEERS for ERECTING COMPLETE STEAM PLANTS

For Electric Lighting and Power Stations.

—: AGENTS FOR :—

ARMINGTON & SIMS ENGINES,
JARVIS BOILER SETTING,
to burn Anthracite Coal and Coke Screenings,
NATIONAL FEED WATER HEATER,
NATIONAL ROCKING and SHEFFIELD GRATE BARS.

61 Oliver Street, Boston.

SEND FOR NEW CATALOGUE.

THE BUTLER HARD RUBBER CO.,

No. 33 MERCER STREET, NEW YORK,

Manufacturers of Hard Rubber Goods of Every Description Including the Celebrated

HARD RUBBER BATTERY CELLS

MANUFACTURED UNDER KIEL'S PATENTS FOR

STORAGE AND PRIMARY BATTERIES.

CHEAPEST AND BEST CELLS IN THE MARKET.

Also SHEET, ROD AND TUBING (Kiel's Patent), for ELECTRICAL PURPOSES at REDUCED PRICES. Standard quality Sheet, Rod, Tubing, Insulator Hooks, Key Knobs, Switch Handles, Telephone Receivers and Battery Syringes constantly on hand. Hard Rubber Specialties of all kinds made to order. Send for Prices and Estimates.

For Sale by CENTRAL ELECTRIC CO., CHICAGO, ILL.

THE BEST

Disque Leclanché Batteries

ARE THOSE MADE BY

J. H. BUNNELL & CO.

OVER 200,000 USED IN THE PAST FOUR YEARS. ALL GIVING ENTIRE SATISFACTION.

ASK ANY ONE OF THE MANY USERS OF THE SAME.

THE REASON WHY, is simply because our processes are the most perfect and our materials used in the manufacture are the very best selections that can be obtained.

PRICES ALMOST, BUT NOT QUITE AS LOW AS THE RULING PRICES FOR INFERIOR MAKE.

Porous Cups, 35 cents, Subject to Discount in Quantity.

ONE OF MANY: "WE ARE USING ABOUT 6,000 CELLS OF BATTERY ON OUR CIRCUITS, AND HAVE AS YET FOUND NOTHING EQUAL TO J. H. BUNNELL & CO.'S DISQUE LECLANCHE BATTERY. Yours, Resp'y, GEO. W. ADAMS, Supt., The Boston Electric Association."

J. H. BUNNELL & CO.,

106 & 108 Liberty Street, NEW YORK.

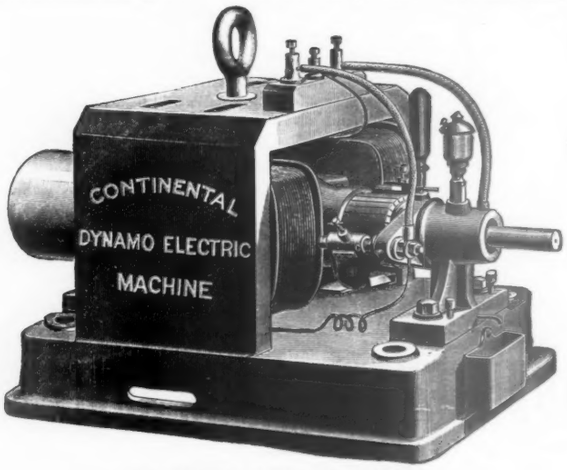
Send for our Latest Catalogue No. 6, of January, 1888.

CONTINENTAL DYNAMO CO.

NEW YORK.

OFFICE: 42 EXCHANGE PLACE. FACTORY: 162 & 164 W. 27th ST.

C. SCHUMACHER, Prest. V. SCHALLER, Treas. P. CLAUS, Supt.



ADVANTAGES CLAIMED:

Simplicity and Solidity of Construction.
Compactness and Small Size.
High Efficiency and No Waste of Power.
No Magnetism Outside.
Accessibility of the Different Parts.
Lower Cost than all other known Dynamos.

BOOKS ON ELECTRICAL SUBJECTS Will be mailed to any address, postage prepaid, on receipt of price. Address, ELECTRICAL REVIEW PUB. COMPANY, 13 Park Row, New York. P. O. Box, 3,329.

PATENTS.

Electrical Review Patent Bureau

Conducts a general business in the preparation and prosecution of Applications for Patents, in the United States and all Foreign Countries. All business carefully and promptly attended to in the matter of Reissues, Caveats, Trade Marks, Labels, Design Patents, Copyrights.

SPECIAL SEARCHES made to determine the question of novelty or infringement.

ELECTRICAL PATENTS A SPECIAL FEATURE. All business receives the direct personal supervision of the Manager, whose fourteen years' experience as Patent Attorney, and seven years as Practical Electrician, insures thorough and satisfactory work.

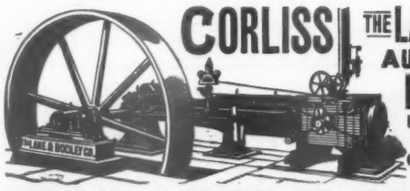
All communications are strictly confidential, and inventors may address us with entire freedom.

Our charges will always be as moderate as first-class work will permit and commensurate with the amount of work to be done.

Address,

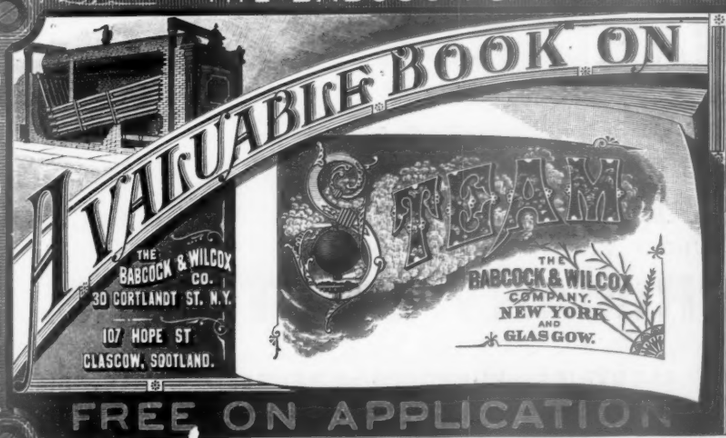
Electrical Review Patent Bureau,

13 PARK ROW, N. Y. T. J. McTIGHE, Manager



THE LANE & BODLEY CO.
AUTOMATIC CUT OFF
ENGINES
Unrivalled for Strength, Durability and Close Regulation.
CONSTRUCTION OF COMPLETE PLANTS A SPECIALTY.
THE LANE & BODLEY CO., 265 to 271 WATER ST., CINCINNATI, O.

THE BABCOCK & WILCOX CO.


AVALUABLE BOOK ON
STEAM
THE BABCOCK & WILCOX CO. 30 CORTLANDT ST. N.Y.
107 HOPE ST GLASGOW, SCOTLAND.
THE BABCOCK & WILCOX COMPANY. NEW YORK AND GLASGOW.

NEW YORK. GLASGOW.

BRANCH OFFICES.
BOSTON, MASS. 8 OLIVER ST.
PHILADELPHIA, PA. 32 N. 5TH ST.
CHICAGO, ILL. 455 JEFFERSON ST.
NEW ORLEANS, LA. 57 CARONDELET ST.
SAN FRANCISCO, CAL. 561 MISSION ST.
LONDON, ENG. 114 NEWGATE ST.
MANCHESTER, ENG. 3 VICTORIA BUILDING
PARIS, FRANCE. 20 BOULEVARD VOLTAIRE.
HAVANA, CUBA. 116½ CALLE DE LA HABANA
MELBOURNE, AUSTRALIA

FREE ON APPLICATION

WATER TUBE STEAM BOILERS.

BALL AUTOMATIC CUT OFF ENGINE
MADE ONLY BY
THE BALL ENGINE CO
ERIE PA.

Eastern Agents, C. B. Vincent & Co., Room 16, 15 Cortlandt St., New York.

BROWNLEE & CO.,
DETROIT, MICH.
DEALERS IN
CEDAR TELEGRAPH POLES.
MANUFACTURERS OF
Cross Arms, Pins and Brackets.
Cedar Ties for Electric Railways.

SAWYER-MAN ELECTRIC CO.

510 to 534 West 23d Street,

NEW YORK.

SEND FOR NEW CATALOGUE OF

Incandescent Lamps and Supplies

ELECTRIC AND COMBINATION FIXTURES.

Series Lamps and Sockets.

CORRESPONDENCE SOLICITED.

GIVES MORE POWER USING LESS WATER THAN ANY OTHER WHEEL.

THE OLD RELIABLE —LEFFEL— WATER WHEEL

SEND FOR CATALOGUE.

JAMES LEFFEL & CO.

SPRINGFIELD, O., OR 110 LIBERTY ST., N.Y.

REGISTER SPRINGS A SPECIALTY.

CARY & MOEN

MANUFACTURERS OF ALL KINDS OF SPRINGS

234 West 29 ST., NEW YORK.

FOR ELECTRICAL INSTRUMENTS

ROYCE & MAREAN,

DEALERS IN

ELECTRICAL APPARATUS

Telegraph and Telephone Supplies,

No. 1408 Penna. Avenue,

Opp. Willard's Hotel. WASHINGTON, D. C.

Alfred A. McCreary.

Patented REFLECTORS, 18 & 20 CORTLANDT ST. NEW YORK.

THE BILLINGS AND SPENCER COMPANY,

HARTFORD, CONN.

MANUFACTURERS OF BILLINGS' PATENT

PURE COPPER COMMUTATOR BARS

FOR ELECTRIC MOTORS OR GENERATORS,

STEEL COMMUTATOR RINGS AND NUTS,

STEEL WRENCHES AND EYE BOLTS.

PATENTED NOV. 6TH 1888

DROP FORGINGS OF COPPER, IRON AND STEEL OF ALL DESCRIPTIONS.

SUNLIGHT CARBONS

The PARKER-RUSSELL MINING & M'F'G CO.

ROOMS, 200 and 202

AMERICAN CENTRAL BUILDING,

ST. LOUIS.

UNIFORM IN QUALITY, LONG LIFE AND GOOD LIGHT.

CHARLES R. VINCENT & CO.,

15 CORTLANDT STREET, NEW YORK,

Ball High Speed Automatic Cut-off Engines

MANNING VERTICAL TUBULAR BOILERS,

Complete Steam Plants Furnished and Erected.

DISTRICT TELEGRAPH SUPPLIES.

All Styles of Call Boxes, Relays, Gongs, Registers, Switches,

Ticket Cases, Batteries, Etc.

Diagrams for erecting District Telegraph Systems furnished FREE with the Outfit.

Magneto Bells and Generators, Battery Bells, Push Buttons.

EVERYTHING KNOWN TO THE TRADE.

CATALOGUE FREE.

VIADUCT MFG. CO., Baltimore, Md.

EXCELSIOR ELECTRIC CO.,

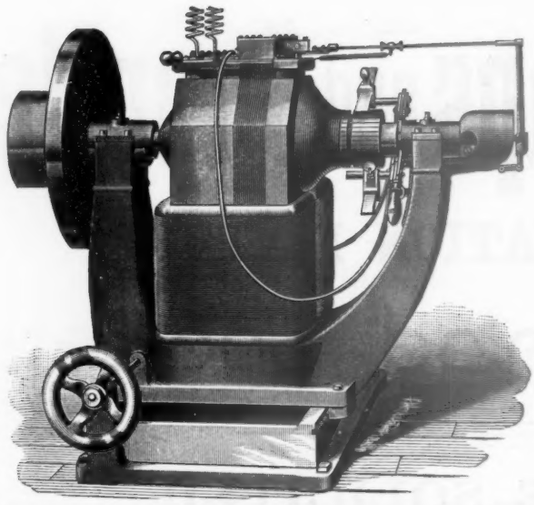
WILLIAM HOCHHAUSEN, ELECTRICIAN.

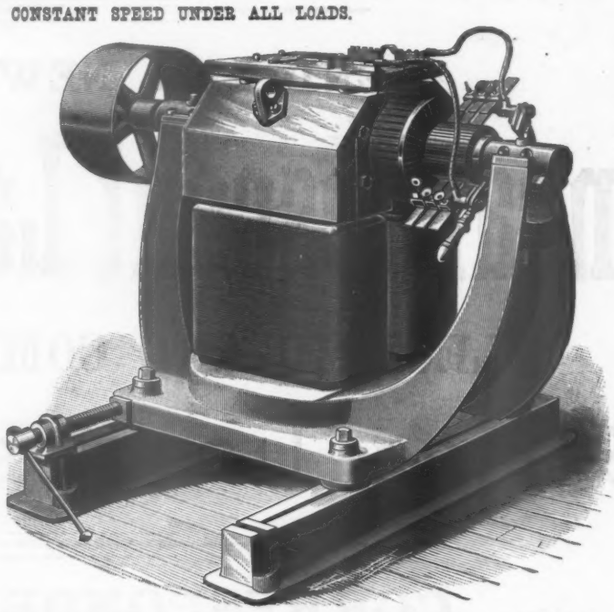
MOTORS

FOR ARC AND INCANDESCENT CIRCUITS.

WOUND FOR ANY CURRENT. PERFECT AUTOMATIC REGULATION

HIGHLY EFFICIENT AND ECONOMICAL. CONSTANT SPEED UNDER ALL LOADS.





OFFICE, 115 BROADWAY, N. Y. WESTERN OFFICE, 11 E. ADAMS ST., CHICAGO.

HOLMES, BOOTH & HAYDENS,

MANUFACTURERS OF

BARE AND INSULATED WIRE,

Underwriters' Copper Electric Light Line Wire, handsomely finished, highest conductivity. Copper Magnet Wire, Flexible Silk, Cotton and Worsted Cords for Incandescent Lighting. Round and Flat Copper Bars for Station Work. Insulated Iron Pressure Wire.

TRADE MARK "K.K."

PATENT "K. K." LINE WIRE

TRADE MARK "K.K."

For Electric Light, Electric Railways, Motors, Telegraph and Telephone Use.

Agents for the WASHINGTON CARBON CO.,

FACTORIES: WATERBURY, CONN.

J. L. BARCLAY, Selling Agent, THE ROOKERY, CHICAGO, ILL.

NEW YORK OFFICE, 25 Park Place, THOS. L. SCOVILL, NEW YORK AGENT.

BOOKS

ON ELECTRICAL SUBJECTS

Will be mailed to any address, postage prepaid, on receipt of price. Address,

ELECTRICAL REVIEW PUB. COMPANY,

13 Park Row, New York. P. O. Box, 3,329.

Bernstein Electric Co.

INCANDESCENT LAMPS

— FOR —

ARC LIGHT CIRCUITS,

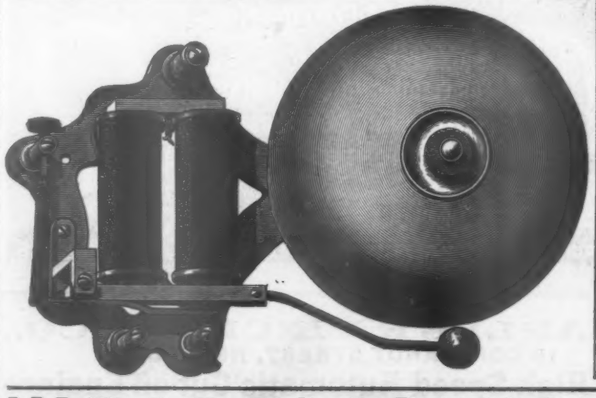
SIMPLE. RELIABLE. DURABLE.

The only safe socket for series lamps and the only socket having insulating material for the outside parts.

Send for Illustrated Catalogue.

620 Atlantic Ave., BOSTON.

Manufacturers



H. E. & C. BAXTER, 18 Fulton Street, Brooklyn, E. D.

WRITE

For the Electrical Review's *New Catalogue* of all Electrical and Scientific Books.

18 PARK ROW, NEW YORK.

Central Electric Company.

OKONITE

TRADE MARK.

GENERAL WESTERN AGENTS,

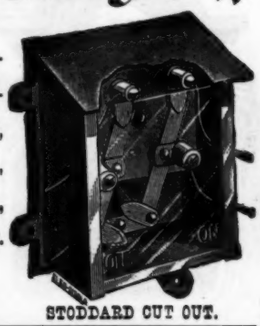
THE OKONITE COMPANY.

Wires, Cables, Tape, Cord, Tubing, Candee Weather-Proof Line Wire.

CLEVELAND SWITCH.

Annunciator Wire, Office Wire, Underwriters Wire, Magnet Wire, Bells, Annunciators, Burglar Alarms, Push Buttons, Insulators, Pins and Brackets, Cross Arms, Step Irons, Compound Soldering Salts, etc., etc. Orders filled promptly and carefully.

42 LA SALLE STREET, CHICAGO.



STODDARD CUT OUT.

COMPOUND. CONDENSING OR NON-CONDENSING.
16 Sizes, 5 to 500 H. P. Not yet equaled by any form of Engine for HIGH FUEL DUTY AND SIMPLICITY.

STANDARD. 13 Sizes in Stock. 5 to 250 H. P.
3,000 in use in all parts of the Civilized World.

JUNIOR. 6 Sizes in Stock, 5 to 50 H. P.
AN AUTOMATIC ENGINE CHEAPER THAN A SLIDE VALVE.
Well Built. Economical. Reliable. Over 300 sold the first year.

All the above built strictly to Gauge with Interchangeable Parts. Repairs Carried in Stock. Send for Illustrated Catalogues.

WESTINGHOUSE ENGINES

The Westinghouse Machine Co.

PITTSBURGH, PA. U.S.A.

SELLING DEPARTMENT IN THE UNITED STATES.

NEW YORK,	17 Cortlandt Street,	Westinghouse, Church, Kerr & Co.
BOSTON, PITTSBURGH,	Hathaway Building, Westinghouse Building,	
CHICAGO,	156, 158 Lake Street,	
PHILADELPHIA,	608 Chestnut St., M. R. Muckle, Jr. & Co.	
ST. LOUIS,	302, 304 Washington Ave.	Fairbanks & Co.
KANSAS CITY,	312 Union Avenue.	
DENVER,	1330 Seventeenth Street,	
OMAHA,	1619 Capitol Avenue, F. C. Ayer.	
PINE BLUFFS, Ark.		Geo. M. Dilley & Sons.
SALT LAKE CITY,	239 S. Main St.	Utah & Montana Machinery Co.
BUTTE, MONT.	E. Granite St.	
SAN FRANCISCO,	21 and 23 Fremont St.,	Parke & Lacy Co.
PORTLAND, OR.	33, 35 N. Front St.,	Parke & Lacy Mch. Co.
CHARLOTTE, N. C.	36 College St.,	The D. A. Tompkins Co.
ATLANTA, GA.	45 S. Prior St.	Keating Imp. & Mch. Co.
DALLAS, TEX.		
CHATTANOOGA, TENN.		C. E. James & Co.

HEADQUARTERS
— IN —
NEW YORK CITY
— FOR —
STANDARD MILLING MACHINES.

UNIVERSAL, LIGHT, OR PLAIN FOR HEAVY WORK.

ALL SIZES READY FOR QUICK DELIVERY.

MACHINES SHOWN IN OPERATION

BY THE MANUFACTURERS,

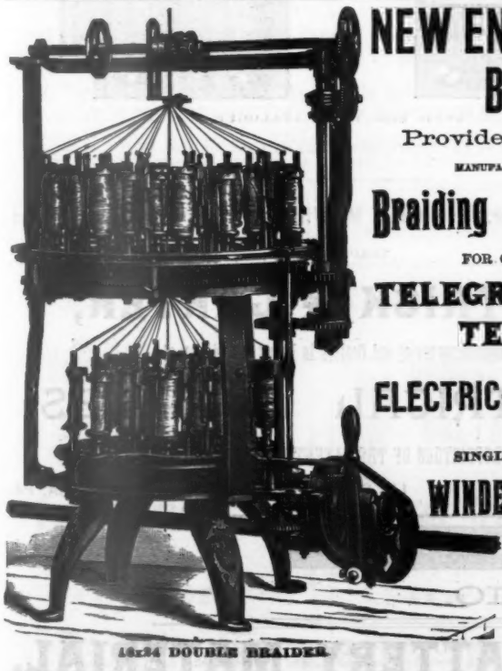
E. E. Garvin & Co.,

LAIGHT & CANAL STREETS, NEW YORK CITY.

SEND FOR ILLUSTRATED CATALOGUE.

WRITE
For the Electrical Review's *New Catalogue* of all Electrical and Scientific Books.

18 PARK ROW, NEW YORK.



16x24 DOUBLE BRAIDER.

NEW ENGLAND BUTT CO.,

Providence, R. I.

MANUFACTURERS OF

Braiding Machinery

FOR COVERING

TELEGRAPH, TELEPHONE

AND

ELECTRIC-LIGHT WIRE

ALSO

SINGLE AND DOUBLE

WINDERS AND BRAIDERS

Of every Description for Silk, Worsted and Cotton Braid.

FINE CASTINGS A SPECIALTY

WILLIAMS & POTTER,

15 CORTLANDT ST., NEW YORK.

Engineers & Contractors,

GENERAL AGENTS,

STRAIGHT LINE ENGINES

BOOKS

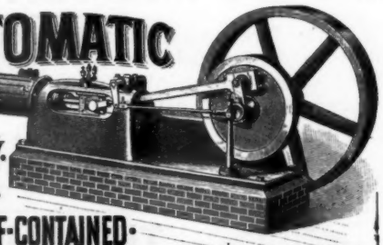
ON ELECTRICAL SUBJECTS

Will be mailed to any address, postage prepaid, on receipt of price. Address,

ELECTRICAL REVIEW PUB. COMPANY,

13 Park Row, New York. P. O. Box, 3,329.

THE PRICE AUTOMATIC



GUARANTEED ECONOMY

REGULATION · DURABILITY ·

SIMPLICITY · SELF-CONTAINED ·

8 TO 300 H.P. SIMPLE & TANDEM COMPOUNDS.

THE JOHN T. NOYE MFG CO. BUFFALO, N.Y.

CHICAGO OFFICE, 64 SOUTH CLINTON STREET.

R. T. WHITE,

12 Pearl St., (Room 6), BOSTON, MASS.

No Bolts through the Rails.

EUREKA CONSTRUCTION

IMPROVED

PATENTED MATERIAL FOR STREET RAILWAY ROADBEDS.

BEST MATERIAL, LOWEST PRICES, CORRESPONDENCE SOLICITED.

THOMAS ASHBURNER, Western Agent, Kansas City, Mo.

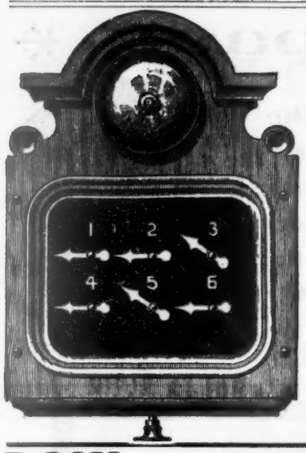
Rolled any weight desired. Patent allowed.
Sample Chair and Section of Rail Sent, Express Prepaid, to Prospective Purchasers.

Mouldings, Cleats, Rosettes.

ADDRESS

WILLIAM B. McLEAN,

Nos. 1038 to 1050 33d ST., PITTSBURGH, PA.



We have added to our list of ELECTRIC BELL SUPPLIES a new Needle Annunciator which we call our "No. 2." ANNUNCIATOR. It is attractive in appearance and well made, and we believe is what has been wanted, namely:

An Annunciator which is Cheap in Price but not Cheap in Appearance.

We propose to furnish Electric Bell Supplies, which can be relied upon, at low prices, and will take pleasure in making quotations.

WESTERN ELECTRIC CO.,

CHICAGO. NEW YORK.

BAIN, 76 Market Street, CHICAGO, ILL.,

General Electrical Work, in all branches of Electrical Engineering. Consultation, etc. Correspondence confidential. TRY ME.

WELLINGTON
Belt Holder
The simplest, cheapest and handiest device in existence for shifting Dynamo Belts. Please write for circulars to
W. R. SANTLEY & CO.
WELLINGTON, O.

Vol. V. 113 Liberty St., New York. Monthly, $2.00 Per Year.

THE STREET RAILWAY JOURNAL, 113 Liberty Street, NEW YORK.

CONTENTS.
Each issue contains 100 pages or more, including 30 pages of reading matter and illustrations
A Directory of Street Railways in the United States and Canada.
A Directory of Manufacturers of street railway appliances and materials.

Is the Best Advertising Medium through which to reach Street Railways.

Ball Electric Light Co.,
18 CORTLANDT ST. NEW YORK

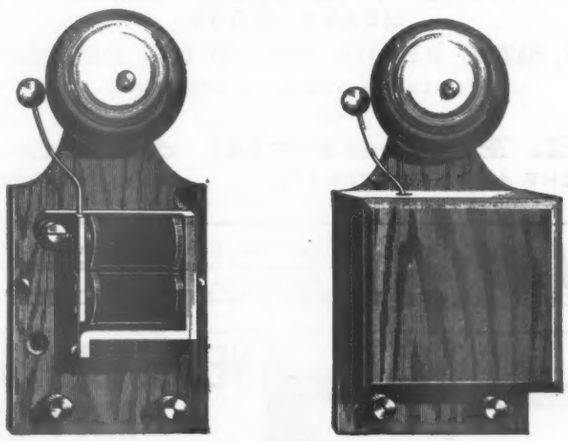
MANUFACTURERS
The Celebrated BALL DYNAMOS and LAMPS
— FOR —
ARC AND INCANDESCENT LIGHTING.

This System is **mechanically** and **electrically** perfect and produces a steady, white and noiseless light with the minimum of expense, both as to the power required and the cost of repairs.

For descriptive Circulars or Testimonials, address

FACTORY: 9th Ave. & 27th St., New York City.
BALL ELECTRIC LIGHT CO., 18 Cortlandt St., N. Y. City.

PARTRICK & CARTER'S
WOOD BOX BELLS
ASH AND WALNUT BOXES.



SEND FOR 1889 CATALOGUE,
And, if in the Trade, inclose Business Card for Discounts.

Franklin S. Carter, Chas. M. Wilkins, E. Ward Wilkins
TRADING AS
PARTRICK & CARTER,
Manufacturers of and Dealers in Every Description of
ELECTRICAL SUPPLIES,
SOLE PROPRIETORS OF THE PATENT NEEDLE ANNUNCIATOR,
ESTABLISHED 1867. 114 SOUTH SECOND STREET, PHILADELPHIA, PA.

ARMINGTON & SIMS ENGINE COMPANY — TRADE MARK — PROVIDENCE, R.I. U.S.A.

THE ARMINGTON & SIMS
AUTOMATIC CUT-OFF ENGINE.
FOR ALL PURPOSES WHERE POWER IS REQUIRED.
CLOSE REGULATION,
ECONOMICAL OF FUEL,
SMALL SPACE REQUIRED,
MODERATE PRICE.
OVER 2,500 ENGINES IN USE.
SEND FOR CIRCULAR.

AMERICAN ELECTRICAL DIRECTORY FOR 1889
PRICE, $5.00.

The best and most permanent medium for advertisers in the electrical field.

The work reaches every electric light and power company in the country, besides telegraph and telephone companies.

This year's issue enlarged and improved.

Lists and reports of electric light and power companies, reports of National Electric Light Association, useful tables, etc., etc.

Send orders for copies of book, and for advertising space to *STAR IRON TOWER CO.*, Publishers of

American Electrical Directory, Fort Wayne, Ind.

THE NATIONAL CARBON CO.
CLEVELAND, OHIO.
MANUFACTURERS OF
ELECTRIC LIGHT CARBONS AND BATTERY MATERIAL.

THE EDDY ELECTRIC M'F'G CO.

MANUFACTURERS OF

AUTOMATIC ELECTRIC MOTORS,

In all sizes, from 1-2 H. P. upward; High Efficiency; Perfect Regulation; Superior Workmanship; Ease of Management; Remarkable Simplicity, etc., etc.

DYNAMO ELECTRIC MACHINES,

For Electro-Plating, Electrotyping, Copper Refining, Etc. No Reversing. No Water. No Noise. No Spark.

SATISFACTION GUARANTEED.

THE EDDY ELECTRIC M'F'G CO., WINDSOR, CONN.

NEW YORK, 33 Church St., BOSTON, 111 Arch St., PHILADELPHIA, 506 Commerce St., CHICAGO, 42 La Salle St., KANSAS CITY, Rialto Building, NEW ORLEANS, 106 Carondelet St.

THE
American Bell Telephone Company,

95 MILK ST., BOSTON, MASS.

This Company owns the Letters Patent granted to Alexander Graham Bell, March 7th, 1876, No. 174,465, and January 30, 1877, No. 186,787.

The Transmission of Speech by all known forms of ELECTRIC SPEAKING TELEPHONES infringes the right secured to this Company by the above patents, and renders each individual user of telephones, not furnished by it or its licensees, responsible for such unlawful use, and all the consequences thereof and liable to suit therefor.

EDISON LAMPS.

FROM 1/2 to 36 CANDLE POWER.

2 1/2 to 40 VOLTS.

For Battery or Dynamos.

CATALOGUE ON APPLICATION.

EDISON LAMP CO., HARRISON, N. J.

Powell's Patent "Signal"

DYNAMO OILERS.

THE BEST IN THE WORLD.

The Filling Hole in top Cap is covered with Snap Lever, which can not be displaced by jarring or shaking of machinery.

Shows oil dropping while machinery runs.

Sight chamber is fitted with square window panes, which are secured by brass end plates, and can be removed for inspection, cleaning or repairs, at any time, while the machine is running.

MANUFACTURED BY

THE WM. POWELL CO.,

Nos. 50, 52 & 54 Plum St., CINCINNATI, O.

Please send for Prices and Discounts.

FIG. 2.

Shows flow of oil stopped when machinery stops.

Flow of oil can be instantly stopped or started, without changing degree of feed.

WRITE

For the Electrical Review's *New Catalogue* of all Electrical and Scientific Books.

18 PARK ROW, NEW YORK.

NEW HAVEN CLOCK CO.,

29 Murray Street, New York.

MANUFACTURERS OF AND DEALERS IN

Electrical Supplies,

Bells, Wire, Relays, Keys, Sounders,

— AND —

EVERYTHING ELECTRICAL.

SEND FOR CATALOGUE ILLUSTRATED IN COLORS.

THE

WESTINGHOUSE ELECTRIC CO.

Pittsburgh, Pa.

Distribution by Alternating Currents.

205 Central Station Plants, Aggregating a Capacity of 328,000 16 Candle Power Lamps, Sold to July 1, 1889.

The United States Electric Lighting Co.

(LEASED AND OPERATED BY THE WESTINGHOUSE ELECTRIC CO.)

SALES DEP'T: 120 BROADWAY, NEW YORK.

COMPLETE ISOLATED PLANTS,
ARC OR INCANDESCENT.
UNSURPASSED FOR DESIGN,
CONSTRUCTION AND EFFICIENCY.

ESTIMATES FURNISHED

SAWYER-MAN ELECTRIC COMPANY,

(LEASED AND OPERATED BY THE WESTINGHOUSE ELECTRIC CO.)

No. 510 WEST 23d STREET, NEW YORK.

INCANDESCENT ELECTRIC LAMPS AND SUPPLIES

FOR ELECTRIC LIGHTING.

Electric and Combination Fixtures.

CORRESPONDENCE WITH DEALERS INVITED.

The Mitchell Vance Company

(SUCCESSOR TO MITCHELL, VANCE & CO.)

DESIGNERS AND MAKERS OF

ARTISTIC

Electroliers & Combination Fixtures

FOR ANY SYSTEM OF INCANDESCENT ELECTRIC LIGHTING.

The feeling is growing that these goods should be specially adapted to the light medium; to meet this want New Designs of Artistic merit and unexcelled finish have been originated which commend themselves to intending purchasers, being shown in Parlors illuminated by Electric light.

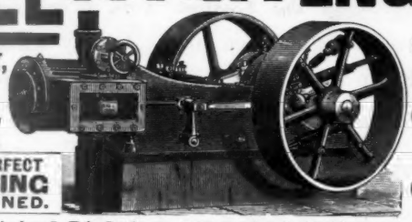
Architects and Decorators Designs and suggestions carried out with fidelity to the given motive.

MANUFACTORY, 24th & 25th Sts. & 10th Ave.

SALESROOMS, No. 836 & 838 BROADWAY, NEW YORK.

BOOKS ON ELECTRICAL SUBJECTS
Will be mailed to any address, postage prepaid, on receipt of price. Address,
ELECTRICAL REVIEW PUB. COMPANY,
13 Park Row, New York. P. O. Box. 3,329.

BALL AUTOMATIC CUT-OFF ENGINE



RELIABILITY,
ECONOMY,
SIMPLICITY,
DURABILITY.
THE MOST PERFECT GOVERNING EVER OBTAINED.

STANDARD
DOUBLE COMPOUND
TANDEM COMPOUND

For Electrical Lighting, Electrical Railways and purposes where perfect governing is required, it has no equal.

BALL ENGINE CO., ERIE, PA.

DEPARTMENT OF ENGRAVING,

ELECTRICAL REVIEW,

13 PARK ROW NEW YORK.

ELECTRICAL ENGRAVING, A SPECIALTY.

SEND FOR ESTIMATES OF CATALOGUE & ELECTRICAL *ENGRAVING*, OF EVERY DESCRIPTION.

WRITE For the Electrical Review's *New Catalogue* of all Electrical and Scientific Books.
18 PARK ROW, NEW YORK.

"THE BEST" OPEN-CIRCUIT BATTERY Is the one which Does the Most Work and Lasts the Longest with the Smallest Amount of Trouble and Expense.

"THE BEST"

Those who have tried **THE "SAMSON"** are Enthusiastic in their Praises. They say it fully meets all these requirements.

THE ELECTRIC GAS LIGHTING CO., BOSTON, MASS. SOLE MANUFACTURING AGENTS FOR THE U. S.

Evolution of the Electric Incandescent Lamp.

By FRANKLIN LEONARD POPE.

8 *vo. cloth;* 100 *pp., with illustrations; price* $1.00.

Whether you make, sell, or use the Incandescent Electric Lamp, or whether you only intend to do so at some future time, you cannot but be interested in the true story of its invention and development. It is a story which until now has been to all intents and purposes unknown; a story of which detached fragments have been buried here and there in the files of forgotten newspapers, in the voluminous archives of the Courts, in the records of the United States Patent Office and in hundreds of other out-of-the-way places. Mr. Pope has ransacked these repositories, and in this book has given us what he found, some of it well repaying the labor of the searcher.

You will find this history—some parts of it—as interesting as a romance; but please understand that it is *not* a romance by any means. It is not, as some romances pretend to be, merely "founded on facts." The facts themselves are presented—good solid facts, too—and moreover the original and contemporaneous authorities are carefully cited by chapter and verse, while important documents are printed in full whenever necessary.

If you want to know how the modern incandescent lamp came to be invented;

If you want to know who invented it, and when it was done;

If you want to understand the important questions involved in the incandescent lamp litigation now going on between the leading electric companies of the United States;

If you want trustworthy facts, figures and dates, as distinguished from vague claims and unfounded assertions;

If you want a reference book and index to the literature of the subject of incandescent lighting;

Then you will procure a copy of this book, read it with thoughtful attention, and keep it by you so that you can get hold of it at once whenever you need it, which will no doubt be frequently.

This book contains among other things of value, a tabular chronology of incandescent lighting, to which you will often want to refer when dates are in question.

8 *vo. cloth;* 100 *pp., with illustrations; price* $1.00.

Any dealer who sells scientific books will supply you with a copy in handsome cloth binding, for *One Dollar.* Or it will be sent by mail post paid, on receipt of price as above, by

HENRY COOK, Publisher,
Elizabeth, New Jersey,
U. S. A.

The Thomson-Houston ELECTRIC RAILWAY SYSTEM

THE FOLLOWING LETTER NEEDS NO COMMENT.

Omaha, Neb., September 9th, 1889.

THE THOMSON-HOUSTON ELECTRIC CO.,
148 MICHIGAN AVENUE, CHICAGO, ILL.

GENTLEMEN:

On last Wednesday we had four dynamos in operation and twenty cars. On that day we moved twenty-one thousand people and were stopped two hours the best part of the day by a public procession; the greater part of these people was moved between noon and nine o'clock in the evening, the heaviest work being done between twelve and three, and four and seven. We pulled at one time eighteen trains heavily loaded, the people standing up and crowded on both cars, hanging on, and the more athletic ones got on top. We moved straight along without a single hitch or break, not even the burning out of a fuse, and at the same time we were operating these trains over grades ranging from one to four per cent. We were also operating two heavy trains on the Burt Street Line, with a nine per cent. grade at one point; so that we have demonstrated to our entire satisfaction that the power is beyond question, and when we get our other four dynamos and the motor service completed, we expect with these eight dynamos to be able to constantly use fifty trains. The line on which this heavy work was done was the most remote from the power house that we now have, and includes the loop in the business part of the city where we have to get up and down gutters, and cross three double track cable roads and four double track horse car roads, all in a distance of three-fourths of a mile; but it seemed to make no difference, the car has moved along the same way.

During the day mentioned and the succeeding day, we moved thirty-five thousand people, and the last day the heavy work was done between four and six o'clock in the evening, the cars loaded the same way as the day before, with the same results, except in one instance a fuse was burned out and stopped the train, which had one hundred and seventy-five people on it, about one minute on a four per cent. grade, and the reason for that stop was that the motor man put in a weak fuse.

Very Respectfully,

THE OMAHA MOTOR RAILWAY CO.,

(Signed) S. D. MERCER, *President.*

THE THOMSON-HOUSTON ELECTRIC CO.,

620 ATLANTIC AVE., BOSTON, MASS. 148 MICHIGAN AVE., CHICAGO, ILL.
WALL and LOYD STREETS, ATLANTA, GA.

EDISON AUTOMATIC DYNAMOS
GIVE ABSOLUTELY PERFECT REGULATION.

Recent tests of four *Edison Automatic Dynamos* in multiple arc show constant pressure at the lamps with load varying from no load to full load, without any adjustment of brushes, regulators, or any parts whatever.

Specially adapted for lighting Theatres, Hotels, Asylums, Stores, etc.

Among the plants in which the *Edison Automatic Dynamos* have been installed may be mentioned the following:

Drexel Building, Philadelphia, 2,000 lights.
Barnes, Hengerer & Co., Buffalo, 1,600 lights.
Star Theatre, Buffalo, 800 lights.
National Theatre, Philadelphia, 1,000 lights.
United States Gunboat "Yorktown," Cruisers "Baltimore" and "Charleston," and Steamer "Pensacola," and a number of other plants.

Edison Automatic Dynamos are now being installed as follows:

New Depot of the Central Railroad of New Jersey, at Jersey City, 2,000 lights.
Steamer "Puritan," of the Fall River Line, 1,600 lights.

Send for Circulars on any class of isolated or Central Station Lighting. Estimates and Specifications Promptly Furnished.

THE EDISON UNITED MANUFACTURING COMPANY,
65 Fifth Avenue, New York.

Forest City Electric Works

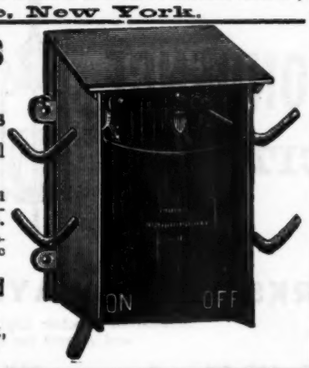
MANUFACTURERS OF

Cleveland's Electric Light Cut-outs

Gang Switches from 5 to 40 Amperes.

Quick make and Break uncontrolled by the Handle.

Correspondence Solicited with Electric Light Companies.



W. B. Cleveland
PROPRIETOR,
183 Seneca Street,
CLEVELAND, O.

EXTRACT FROM THE REPORT
— OF —
DR. SCHUYLER S. WHEELER,
— ON —
Underground Arc Light Wires in New York.

The line in 125th Street, 2,000 feet in length, is laid in the small ducts of the Johnstone system of conduits. The cable is a ***BISHOP GUTTA PERCHA WHITE CORE,*** and was laid immediately after the order for the work was given. The cable was connected to overhead arc light wires by running it up in a two-inch iron pipe fastened to the outside of an ordinary city electric lamp post. Connections were made with lights in front of stores by carrying the cable from the ducts in iron pipes under the sidewalk and up the front of the stores. This line has been in continuous use for two months, carrying a pressure of 2,500 volts, and it shows an actual rise in insulation with age and use, as will be seen from the following tests:

Jan. 11th, 1,100 Megohms.
Feb. 12th, 1,800 Megohms.
April 12th (including eight arc lamps and branch leads), 2,000 Megohms.

All our White Core India Rubber Insulation is Same Quality as on above cables.

BISHOP GUTTA PERCHA CO.,
420-426 EAST 25TH ST., NEW YORK.

THE CELEBRATED

TRADE MARK REGISTERED

P. AND B.

ELECTRICAL COMPOUNDS.

THE STANDARD PAINT CO.,
59 Maiden Lane, N. Y.
RALPH L. SHAINWALD, President.

THE PUBLIC

Is respectfully informed, for its own protection, that we have sued the LECLANCHE BATTERY CO., in the U. S. Circuit Court, for making and selling batteries which infringe our

Patent No. 405,246,

and that corporations or persons having in use or vending such batteries, are incurring liability therefor.

IN THE EVENT OF A FAVORABLE JUDGMENT, WHICH WE CONFIDENTLY EXPECT, WE SHALL EXACT FULL DAMAGES FOR EVERY CELL.

Law Telephone Company,

112 LIBERTY STREET, WILLIAM A. CHILDS, President.
New York, September 17, 1889.

Weitmyer Patent Furnace,
MANUFACTURED AND SOLD BY
Foundry and Machine Department Harrisburg Car Manufacturing Co.
HARRISBURG, PA.

TDE AUTOMATIC ENGINE, PORTABLE & TRACTION ENGINES
STEAM ROAD ROLLERS, BOILERS OF ALL DESCRIPTIONS.
New York Office, Messrs. Fleming & Kimball, 17 Dey Street.
New England Office, Messrs. John Post, Jr. & Co., 70 Kilby St., Boston.
Baltimore Office, Messrs. Thomas K. Carey & Bro., 26 Light St., Balt.
WESTERN OFFICE, MESSRS ENGLISH, MORSE & CO., KANSAS CITY, MO.

GRIMSHAW WHITE CORE INSULATED WIRE

Grimshaw Patented White Core WIRES and CABLES.

FIRE, ACID, AND WATERPROOF. GRIMSHAW TAPE.

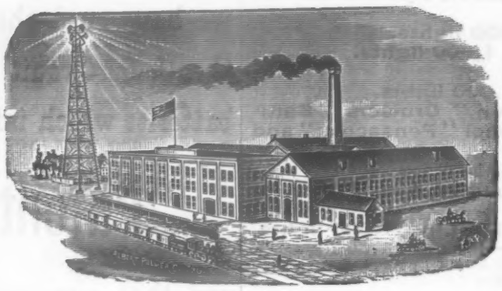
NEW YORK INSULATED WIRE Co.,
R. E. Gallaher, Secretary. Sole Manufacturers,
J. W. Godfrey, Gen'l Manager.
W. B. Dowse, Treasurer.
649 & 951 BROADWAY, N. Y.

THACKARA MANUFACTURING CO.,
DESIGNERS AND MAKERS OF
GAS, ELECTRIC AND COMBINATION FIXTURES
For any Incandescent System.
Philadelphia, Pa.

Fort Wayne Jenney Electric Light Company,

FORT WAYNE, IND.

The most carefully worked out and Complete Alternating System of Electric Lighting in existence. Armatures and Converters guaranteed. 12-16 candle-power Lamps to the mechanical horse power guaranteed.



MANUFACTURERS
OF THE
SLATTERY INDUCTION SYSTEM
OF
Incandescent Lighting
AND THE
Original Jenney System
OF
ARC LIGHTING.

SLATTERY DYNAMO, LAMP AND CONVERTER.

CORRESPONDENCE SOLICITED.

JENNEY DYNAMO AND LAMPS.

MAIN OFFICE AND WORKS, FORT WAYNE, IND.

New York Office, Room 45, 115 Broadway.

Manhattan Electric Light Co., 511 Broadway, Sole Licensees and Agents for New York City and Brooklyn.

CHICAGO OFFICE, 185 Dearborn St., *W. J. BUCKLEY, Manager.*

PHILADELPHIA OFFICE, 907 Filbert St., *G. A. WILBUR, Manager.*

SAN FRANCISCO OFFICE, 217 Sansome St.

F. ADAM SUC'S; CITY OF MEXICO.

THE

TUCKER ELECTRICAL CONSTRUCTION CO.

14-20 Whitehall St., New York City.

* * * * * * * * * * * * *

CONTRACTORS FOR

HIGH GRADE CONSTRUCTION WORK.

* * * * * * * * * * * * * * *

Correspondence of Electric Light Companies Solicited.
Refer to some of the Most Prominent Buildings in New York City.